REIN

Automatic Siphonic Apparatus as used in Sewerage Systems and in Sewage Purification Plants

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AUTOMATIC SIPHONIC APPARATUS AS USED IN SEWERAGE SYSTEMS AND IN SEWAGE PURIFICATION PLANTS

BY

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

LESTER EDWARD REIN

ENTITLED AUTOMATIC SIPHONIC APPARATUS AS USED IN SEWERAGE SYSTEMS AND IN SEWAGE PURIFICATION PLANTS

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF Bachelor of Science in Municipal and Sanitary Engineering

A N Talbot

HEAD OF DEPARTMENT OF Municipal and Sanitary Engineering

AUTOMATIC SIPHONIC APPARATUS AS USED IN SEWERAGE SYSTEMS AND IN SEWAGE PURIFICATION PLANTS.

The steady growth of population and its concentration in cities and towns has made it necessary that more time and study be devoted to the sanitary conditions and health of the people in such communities. Experience has taught that negligence in the disposal of sewage and putrifying matter has in many cases resulted in epidemics of contagious diseases. Better scientific knowledge of the principles and methods of sewage purification have been of great aid in the solution of this important problem. The development has been comparatively slow, but at the present time the general knowledge is such that sewerage systems are built which will prove far more satisfactory than those of fifteen or twenty years ago.

First of all the sewers should be kept free from deposits of decaying vegetable matter. This can be accomplished by means of periodic flushing, either hand or automatic, the latter without a doubt being the best wherever the conditions will allow of its use. Then the sewage after having been collected at some central point, should be given some preliminary treatment before its final disposal. The general practice in this respect has been that of septic action followed by intermittent filtration, either in the form of sand filters or contact beds.

The first part of this thesis will be devoted to the several kinds of siphons used for the flushing of sewers, and the second part to the automatic siphonic apparatus used to

control the flow of sewage from the septic tank onto the filter or contact beds.

P A R T I.

SIPHONS FOR FLUSHING SEWERS.

THE FIELD WARING.

Among the siphons that have withstood the test of public use with any degree of satisfaction are the Field-Waring, Van Vranken, Rhoads-William, Miller, Berry, Walker and De La Hunt. Of these the Miller and Rhoads William are the only ones in general use at the present writing.

The principle upon which these siphons work is much the same in every case, most of them being different forms of the Rhoads William the patent of which has expired.

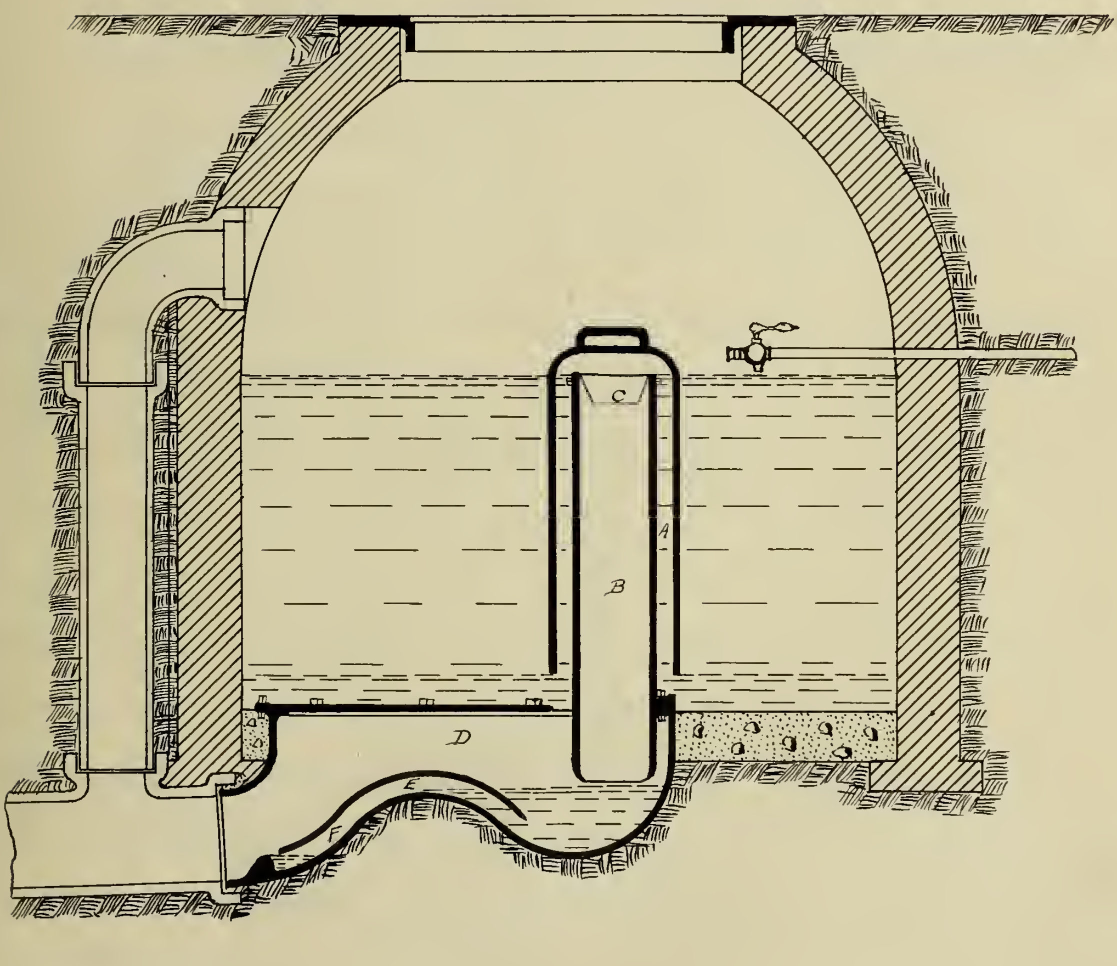
The first siphon upon the market and probably the best known of the earlier siphons, is that invented by Rogers Field and improved by Col. George E. Waring Jr. and known as the Field-Waring siphon.

The siphon proper, Plate 1, consists of a round intaking limb A and a discharging limb B. At the top of the latter is an annular lip C, the bottom of which is tapered to a diameter less than that of the discharging limb B. At the bottom of the discharging limb is a weir chamber, D being the chamber and E the weir. When the chamber is filled to the crest of the weir, the end of the discharge limb is just sealed. The siphon is brought into action in the following manner:- The water rising in the tank reaches the annular lip and flows over and down into the weir chamber without having touched the sides of the discharge limb. This soon seals the end of this limb, and further flow of water over the lip will carry some of the confined air out, thus

causing a slight rarefaction. This rarefaction causes the water in the intaking limb to rise somewhat higher than the water in the tank, and so increases the flow over the annular lip. This increases the rarefaction and finally the siphon is brought into full operation. The water is then drawn out of the tank to the bottom of the intaking limb. The small auxiliary siphon, shown over the crest of the weir at F begins to work and takes the water out of the weir chamber. This allows the air to enter the discharging limb thus venting the siphon and preparing it for the next rise of water in the tank.

This style of siphon has several objectionable features. First of all, it is necessary that the siphon be air tight, and it is a difficult matter to bolt the several pieces together and have the joints absolutely tight. Again all foreign matter must be excluded from the tank otherwise the auxiliary siphon would be likely to clog up and thus prevent the main siphon from operating. It is also necessary to be very particular in setting the siphon, for should the crest of the weir be below the bottom of the discharging limb the latter would never be sealed. The objections were too proncunced to overcome. This form of siphon was used in many places and for a time seemed fairly satisfactory, but as simpler types were put upon the market the demand for it decreased and at the present writing it is no longer used.

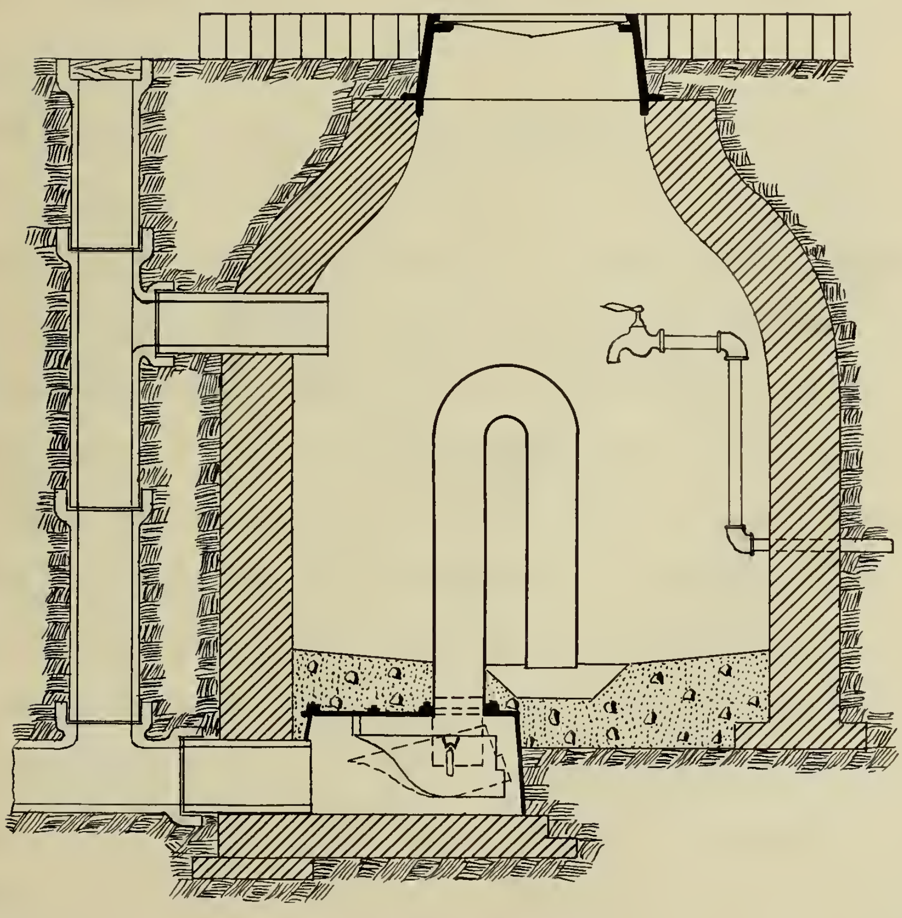
FIELD-WARING SIPHON.



THE VAN VRANKEN SIPHON.

The Van Vranken was one of the few forms of siphon depending upon moving parts for its operation, which met with any degree of success. As is shown in the drawing on Plate II. the siphon consists of siphon leg, a tilting pan, and a cast iron box connecting with the sewer. The siphon leg is bolted to the cast iron box, and the tilting pan or trap instead of being fixed is hung on bearings under the siphon leg and is so balanced that when it is nearly filled its center of gravity moves forward, the pan tilts over, and a portion of the water is spilled out. The water in the tank has previously risen to a height above the lower bed of the siphon leg equal in amount to the depth of water in the tilting pan and thus the two columns of water were kept in equilibrium. The sudden spilling of water from the tilting pan destroys this equilibrium and causes the long leg of the siphon to become filled with water under a slight head. This brings the siphon into full operation and it continues to discharge until the water is drawn from the tank down to the bottom of the short leg of the siphon. When it reaches this point air is admitted and the action ceases. The pressure being removed the tilting pan returns to its horizontal position and the operation is repeated at the next rise of water in the tank. This form of siphon was found to work well for a certain period of time; but it was discovered that even though the tilting pan were constructed of cast iron it would sooner or later rust up and the siphon would be rendered useless.

VAN VRANKEN SIPHON.

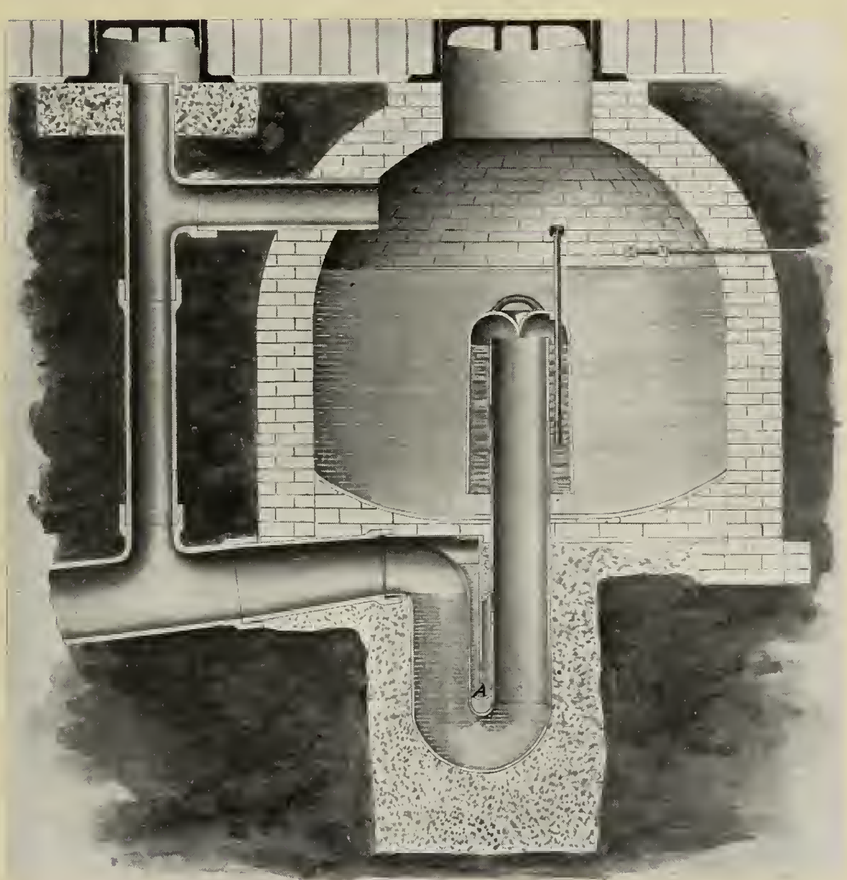


THE RHOADS WILLIAM SIPHON.

The Rhoads-William is the oldest and perhaps the best of what is known as the double trap siphons. As finally perfected and as it is still made, the Rhoads William siphon consists of but two castings, the bell and the main trap. Between the two legs of the main trap is cast an auxiliary blow off trap having a depth of seal two or three inches less than that of the main trap. See Plate III.

The operation is simple. The rise of water in the tank compresses the air in the bell and so forces the water in both traps down. This continues until the water level stands at the level of the bend A in the auxiliary blow off traps. Any additional pressure forces some of the air around this bend and out into the sewer. At the same time the water is forced out of the blow off trap thus quickly releasing all the air confined in the bell; this destroys the equilibrium and brings the siphon into operation. This siphon has been fairly successful, an important element of its success being the fact that the auxiliary blow off trap is cast with the main trap, thus avoiding leaks and reducing the liability of rusting shut to a minimum. However, it is subject to clogging by foreign matter and hence it is useless in some cases. It is as near perfection as may be expected for the form which depends upon an auxiliary device for its operation.

RHOADS-WILLIAMS SIPHON.

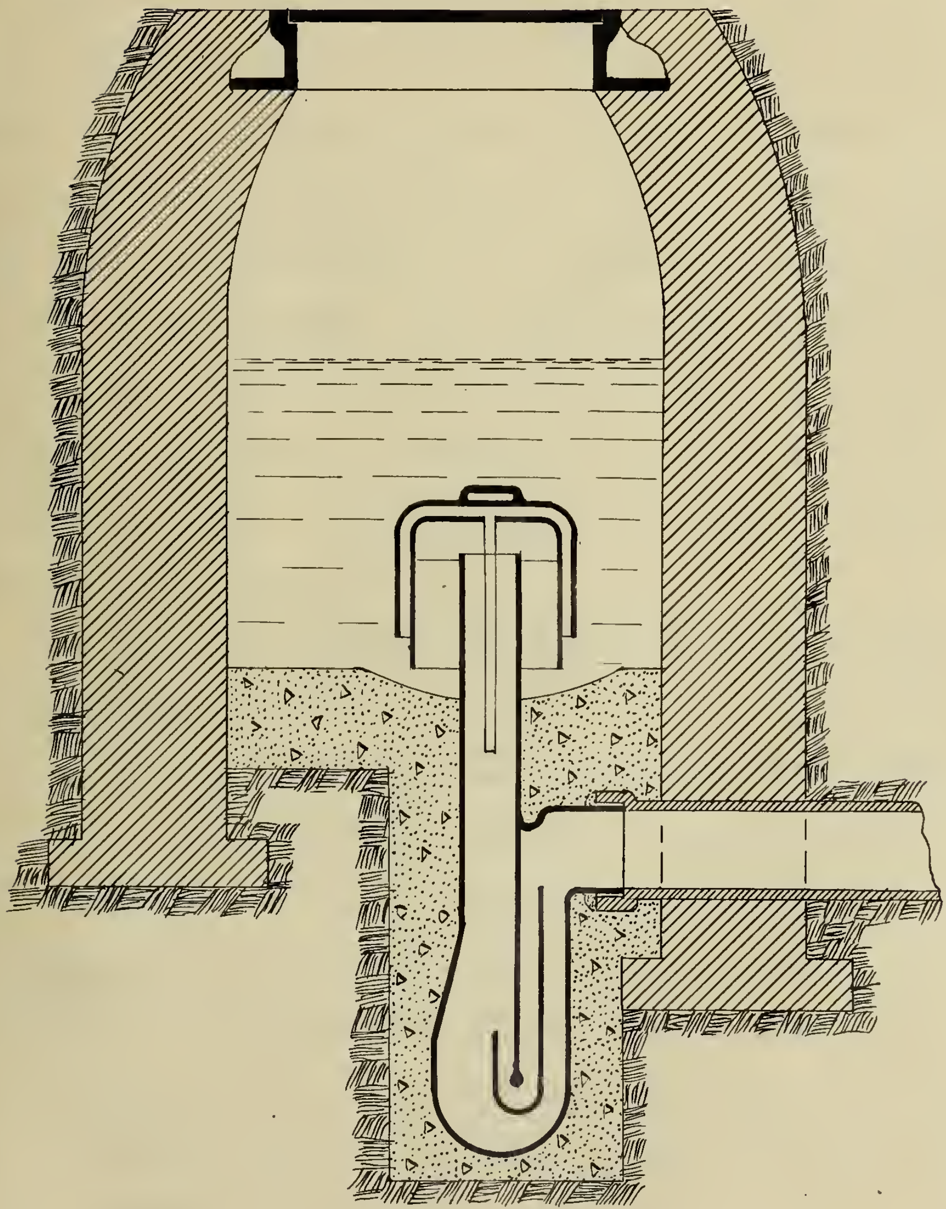


THE WALKER SIPHON.

The Walker siphon is a modification of the Rhoads William with some additional features. As is shown in Plate IV. it consists essentially of two castings. First there is a main discharge trap having within it a smaller or auxiliary blow off trap. The second piece or bell fits over the top of the main trap and is held in place by brackets, fastened to the bell and trap. Running up each side of the bell and directly opposite each other are two openings which meet in the center of the top of the bell. From this point a pipe runs down into the main trap to a point a short distance below the bottom of the bell. The trap being filled with water, the supply pipe is turned on in the tank. As the water rises the bottom of the bell is sealed and then the two openings in the side. When the seal is complete the pressure of the air in the bell forces the water down in the trap, and finally brings the siphon into operation in just the same manner as in the case of the Rhoads William. The water in the tanks is drawn down to the bottom of the bell, the siphon is vented and prepared for the next operation.

Probably the most serious objection to this form of siphon, is the fact that the auxiliary blow off trap is directly exposed and will admit any foreign matter that might drop into the trap and be carried over by the siphon. Should this trap become clogged the siphon is useless.

WALKER SIPHON



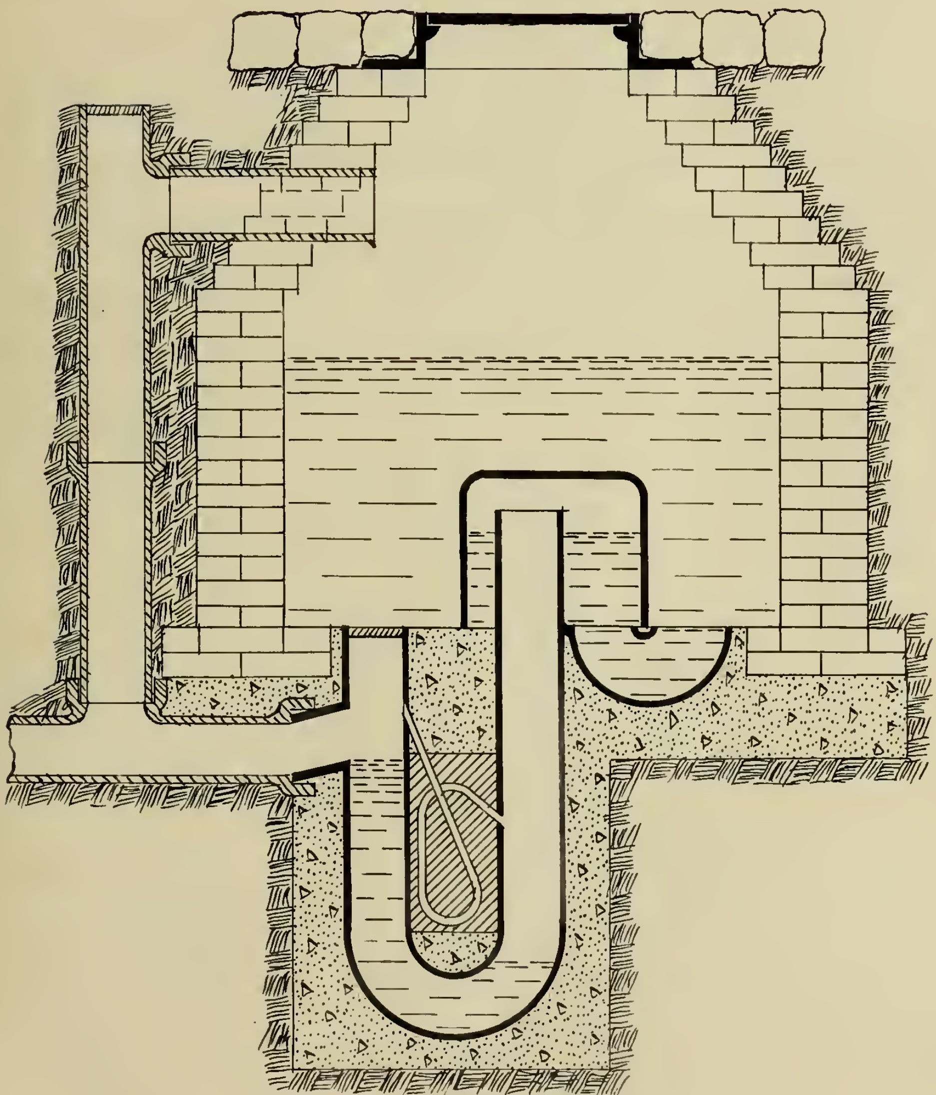
THE BERRY SIPHON.

In Plate V. the Berry siphon is shown to consist of three pieces. The main trap and the discharge mouth connecting it to the sewer and the part which leads from the short leg of the trap to the floor of the tank are all cast in one piece. A half circle of cast iron pipe is set in the tank, both ends being flush with the floor and one end being set close to the long leg of the siphon. The bell sets upon the floor of the tank and is held in place by its own weight. This bell is set in such a position that it covers the end of the half circle of pipe next to the long leg of the siphon. Between the two legs of the siphon is cast an iron web, along side of which is a wrought iron blow off trap in the form of a loop.

The operation of the siphon is the same as that of the Rhoads William or Walker.

The only added feature of the siphon is the half circle of pipe. The siphon continues to operate until the water is drawn down to the level of this pipe. This device removes all the water from the tank which is a very good feature. The objection is the same as for any double trap siphon. The small trap is always exposed to clogging. In this particular case the blow off trap is made of wrought iron whose life is much less than that of the cast iron in the main siphon.

BERRY SIPHON.

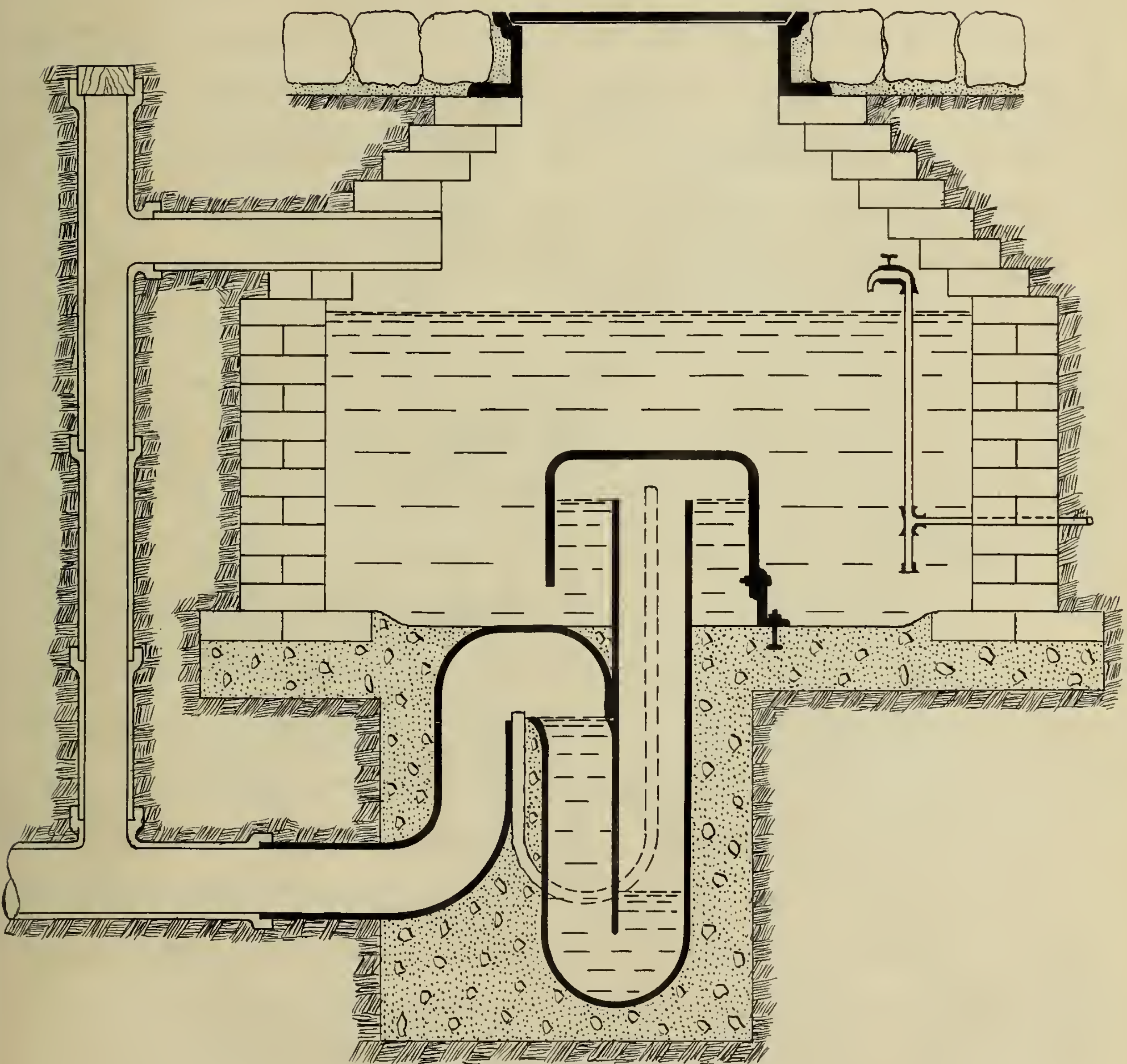


THE DE LA HUNT SIPHON.

The De La Hunt siphon, shown in Plate VI. is constructed and works on much the same principle as the other double trap siphons already described. It consists of a bell, main trap and an auxiliary blow off trap. The only material difference lies in the fact that the blow off trap is made adjustable so that different discharging heights may be obtained.

The objections to this style of siphon are the same as those already mentioned for double trap siphons. The life of the auxiliary is much shorter than that of the main trap, and being embedded in the concrete is impossible to get at without removing the entire siphon.

DE LA HUNT SIPHON.



THE MILLER SIPHON.

The Miller is the only siphon now made that depends on neither exhaustion nor auxiliary devices for its operation and is generally acknowledged to be the simplest and most efficient form of siphon now in use. The vital part of this siphon lies in the free projection of the overflow edge of the short leg of the trap, and its function can easily be seen in the operation. The siphon proper consists of two parts, the discharging limb or trap and the intaking limb or bell, the latter being placed over the long leg of the trap and held in place by its own weight. Plate VII.

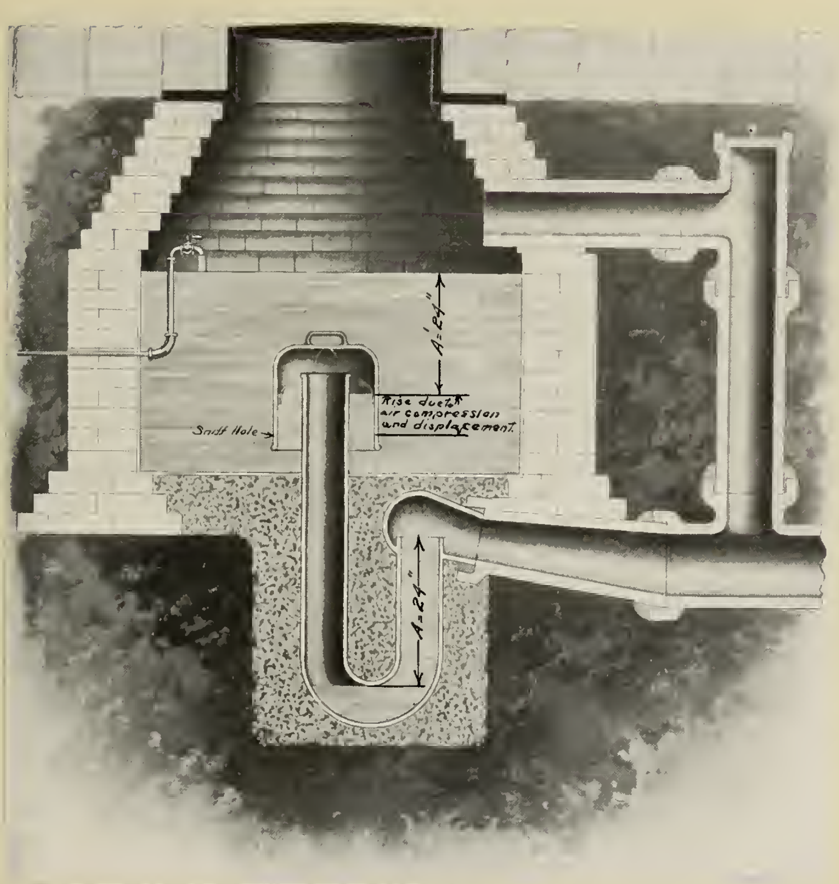
The trap is first filled with water and the bell put in place. The water being turned on in the supply pipe rises in the tank and when above the bottom edge of the bell encloses the air and puts it under pressure as the water in the tank rises. The confined air gradually forces the water out of the long leg of the trap. Finally a point is reached when the confined air is just about to escape around the lower bend of the trap. At this point the difference of level between the water in the two legs just equals the difference of level between the water in the tank and the water in the bell. Thus the two columns are in equilibrium. As soon as the depth of water in the tank is increased by a further supply, no matter how small, some of the air will be forced around the lower bend of the trap. By this upward rush of air some of the water in the short leg is thrown out. This destroys the equilibrium between the two columns of water and allows the long leg of the siphon to suddenly become filled

with water, which brings the siphon into immediate operation.

The free projection of the short leg of the trap, gives the water thrown up by the air a chance to escape over its side and down the sewer. In the ordinary siphon this water would fall back in the short leg of the trap and so choke the operation.

The siphon draws the water from the tank until the bottom of the bell is reached. The action ceases and the siphon vents through a 3/8" sniff hole, which is bored about two inches above the bottom of bell.

MILLER SIPHON.



DESIGN AND CONSTRUCTION.

What is known as the Miller Standard Design Siphon, shown in Plate VII. is made in four sizes, the diameter of the trap indicating the size, it being in four cases, three, five, six and eight inches. These siphons discharge at depths of 18, 27, 36 and 42 inches, measured from the bottom of the tank to the high water line. These depths are governed by the different proportions of the siphon, but mainly by the depth of the trap A, this depth may be varied two or three inches by raising or lowering the sniff hole in the bell. The actual depth can be very closely determined and in order to bring out the several points, the discharging depth of a 6" Miller siphon will be computed.

The cut on Plate VII. shows the siphon just about to discharge. At the beginning of the action there is no water in the tank or bell and the water level A is the same in both legs of the trap. When the water in the tank rises above the sniff hole, the air in the siphon begins to compress and forces the water in the long leg down, until just as the siphon is about to discharge, the different water levels exist as is shown in the cut. The two columns A and A' will equal and will just balance each other.

The rise of water in the bell B is due to two things. The rise due to the displacement of half the water in the trap and that due to the compression of the air in the bell and trap. The first is readily computed, for the volume of water displaced in the trap there is a rise of the same volume in the bell, that is, not counting that part of the bell below the sniff hole.

The depth of the trap in a 6" siphon being 2'0", the volume of water displaced is 24 x 28.27 = 678.5 cu.in. This same volume of water must rise in the bell, after the sniff hole has been sealed, the available area over which this volume is distributed is the area of the bell less the area of the leg of the trap or 227.0 - 35.25 = 191.5 sq.in. The rise of water in the bell will therefore be 678.5 ÷ 191.5 = 3.5 in.

This action all takes place under a head of 2 ft. The per cent reduction of the volume of air due to compression is $\frac{\text{Head}}{34 + \text{Head}} = \frac{2}{34 + 2} = 5.5\%$. The total volume of air in the bell and trap when the siphon is sealed is 1907.10 cu.in. The reduction in volume is therefore 1907.10 x .055 = 114.8 cu.in. This is also divided over the area of 191.5 sq.in. 114.8 ÷ 191.5 = .55 in. or the rise of water due to compression of the air. As is shown in Plate VII. the total discharging depth is found by adding the depth of the trap to the rise due to displacement and compression.

RATES OF DISCHARGE.

3" siphon discharges 0.2 Cubic feet or 1.5 gallons per second.

5" siphon discharges 0.65 Cubic feet or 5.0 gallons per second.

6" siphon discharges 1.00 Cubic feet or 7.5 gallons per second.

8" siphon discharges 2.00 Cubic feet or 15.0 gallons per second.

PART II.

APPARATUS FOR USE IN SEWAGE PURIFICATION PLANTS.

Necessity has been largely responsible for the rapid strides made in improving methods of sewage purification. It is generally conceded that as a preliminary treatment the septic tank is the best for many cases. As a secondary treatment either sand filtration or the contact system may be used, each having its advantages and disadvantages. Very often local conditions will decide between the two.

A sewage purification plant should be simple and operate with the least attendance possible. The part of the plant requiring the most attention is that which changes the flow of sewage from one bed to another at certain regular intervals. To do this by hand is expensive and unsatisfactory. Apparatus has been invented which when properly designed and installed will control the flow of sewage and reduce the cost of operating the plant to a very low figure. In placing sewage upon filter or contact beds, one of the things necessary for the high efficiency of the plant is that the sewage be spread rapidly and evenly over the beds.

To aid in this operation many kinds of apparatus have been invented, both with and without moving parts. As yet none has reached a degree of perfection which will allow of being left alone to automatically and successfully operate the plant. It has however been conclusively demonstrated in practice that the use of certain forms of apparatus will reduce the cost of operation and maintenance to a very low figure and it is the

opinion of the writer that in the near future sewage purification plants will be designed and installed which will use a form of apparatus absolutely automatic in operation.

Two men whose time and efforts in this line of invention have resulted in the production of apparatus which has been successful to a very great degree, are Sidney W. Miller in this country and Samuel H. Adams in England. Both have in most cases used the Miller siphon heretofore described as a foundation upon which to build their different appliances. By coupling two or more siphons together with iron piping they have produced an apparatus which has been a great aid in perfecting a simple system of sewage disposal.These will be called alternating siphons.

Two,three or four or any number of siphons can be so arranged that they will successively operate; that is, there being one siphon for each bed, each siphon will in turn discharge the contents of the dosing tank in which it is set upon the bed to which it is connected. The process is continuous and is accomplished by means of iron piping, there being no moving parts in any of this apparatus.

The principle is simple and the same in all cases. If two or more siphons having the same depth of trap are placed in the same tank, that siphon whose trap contains the least water will be the one to operate at the next rise of water in the tank. The problem then resolves itself into the filling of all the traps with the exception of the one which it is desired shall operate next .

The application of this principle will be shown in the following explanation of the several forms.

THE ADAMS DOUBLE ALTERNATING SIPHONS.

Samuel Henry Adams discovered that two siphons of the same style and size when placed at approximately the same elevation in the same tank, with no connection whatever between them, would alternate at each rise of water in the tank. This fact is brought about in the following manner.

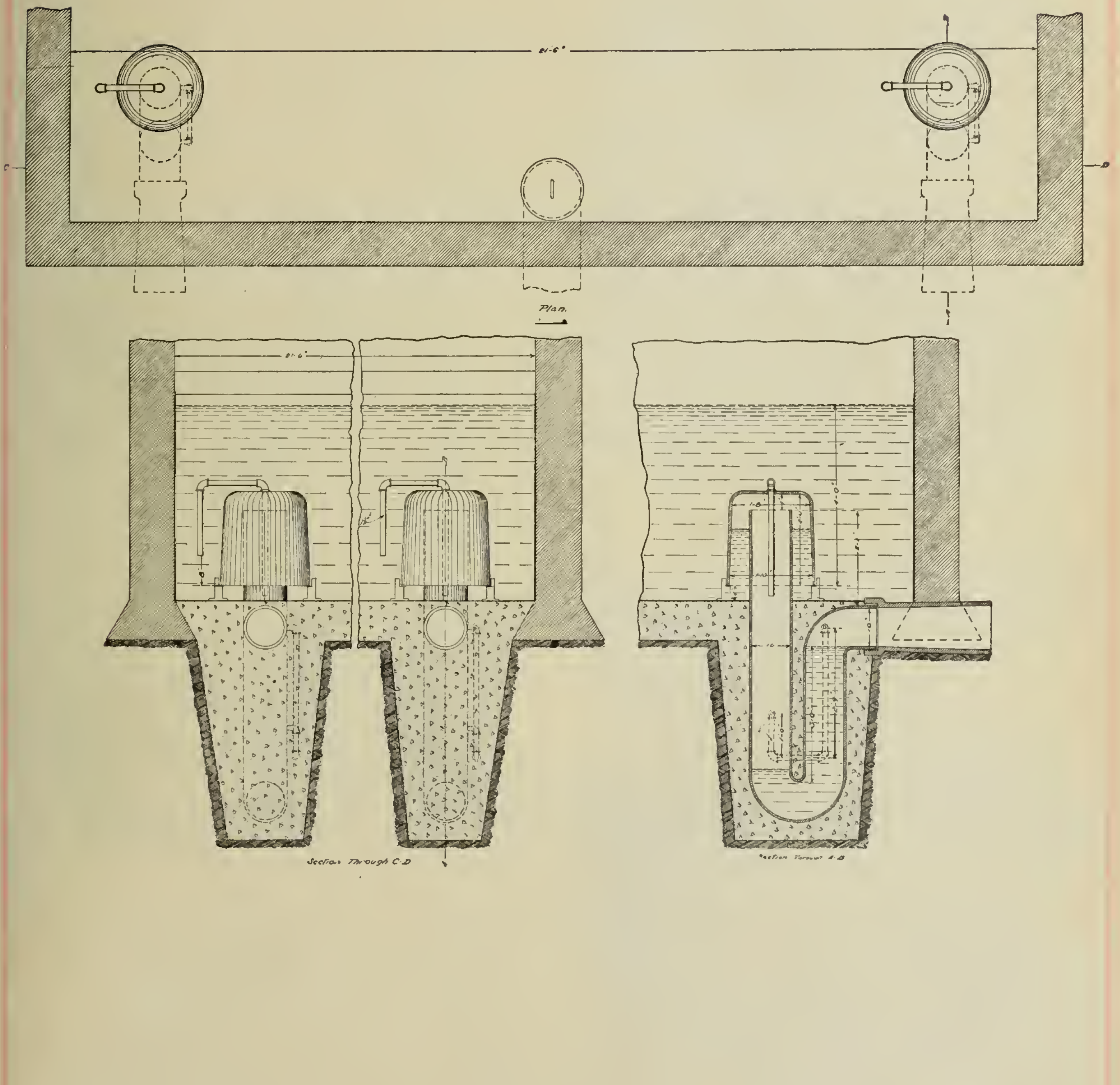
The traps of both siphons being filled with water and the bell put in place, the supply stream is turned into the tank. The rise of water seals the siphon, compresses the air in the bells and forces the water in the long leg of the trap out, in exactly the same manner as was done in the single siphon. In case both traps were at exactly the same elevation, both siphons would be brought into operation at the same instant but in practice it is almost impossible for this condition to exist and any slight difference is sufficient to cause one of the siphons to be brought into operation a trifle in advance of the other, this however applies only to the first discharge as there after it is definately known which siphon will discharge next.

When the water rises in the tank, half the water in each trap is forced out. One siphon operates leaving the other standing idle, the siphon in operation drains all the water from the tank down to the bottom of the bell, at this point it vents and ceases to operate, leaving its trap standing full. As the water is drawn from the tank by the siphon in operation, the pressure on the idle siphon is gradually reduced, until the remaining water assumes its natural level but this trap is only half full, the other half having been forced out by the rise of water in the tank. The trap

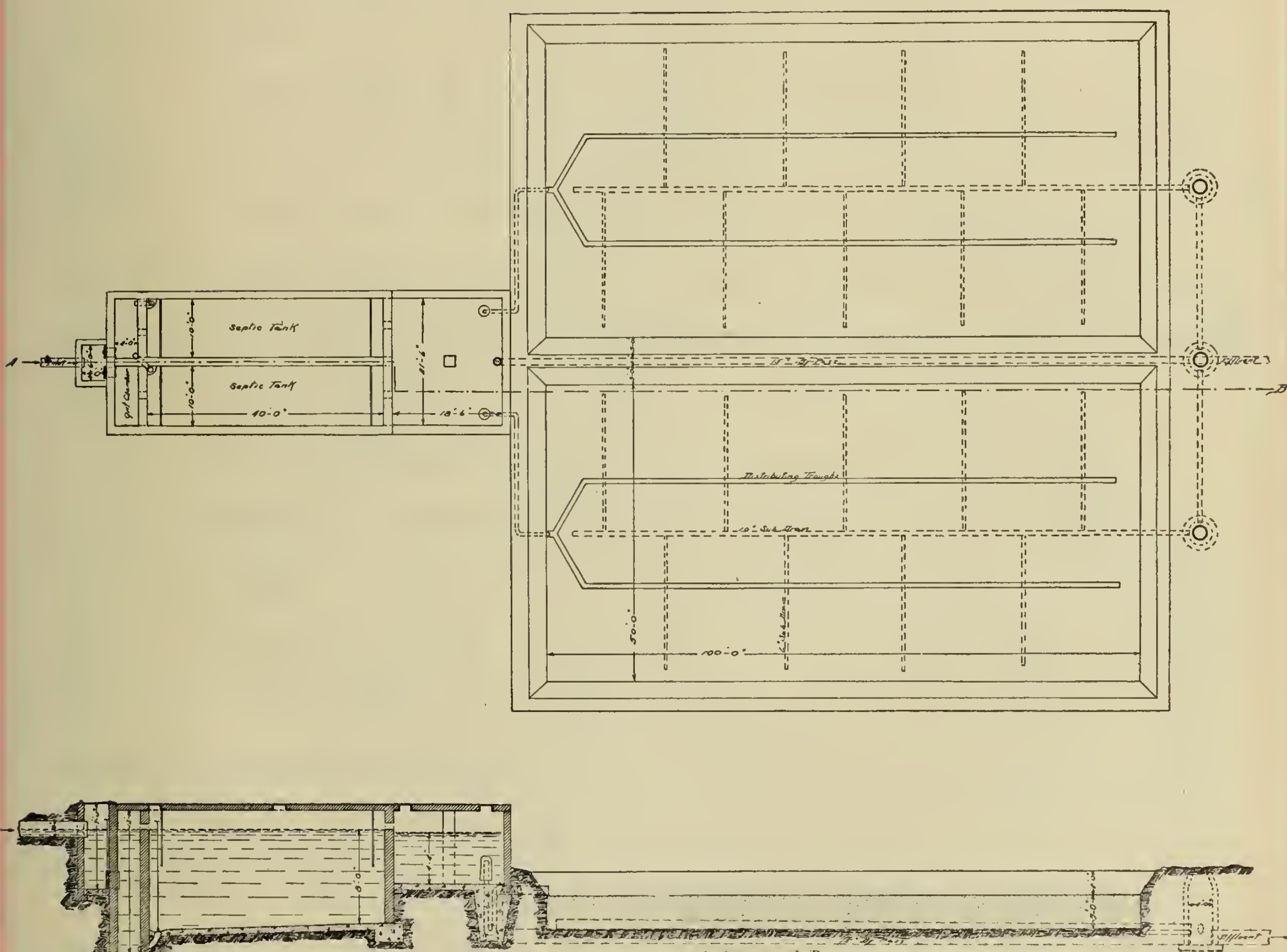
of the siphon which has just ceased operating is full. From this it can be seen that at the next rise of water, that siphon whose trap is only half full will be brought into operation in advance of the one whose trap is full.

On the following page is shown a drawing of two alternating siphons, as well as a general plan showing their application to a sewage disposal plant using a septic tank and two intermittent downward filtration beds.

Details of Adams Double Alternating Siphons.



General plan of a Sewage Purification Plant showing the application of the Double Alternating siphons Capacity of plant is 100,000 gallons per day.



THE ADAMS TRIPLE ALTERNATING SIPHONS.

The principle upon which the triple alternating siphons operate is the same as that used in the double alternating. There is however another condition which makes the operation a little more complex.

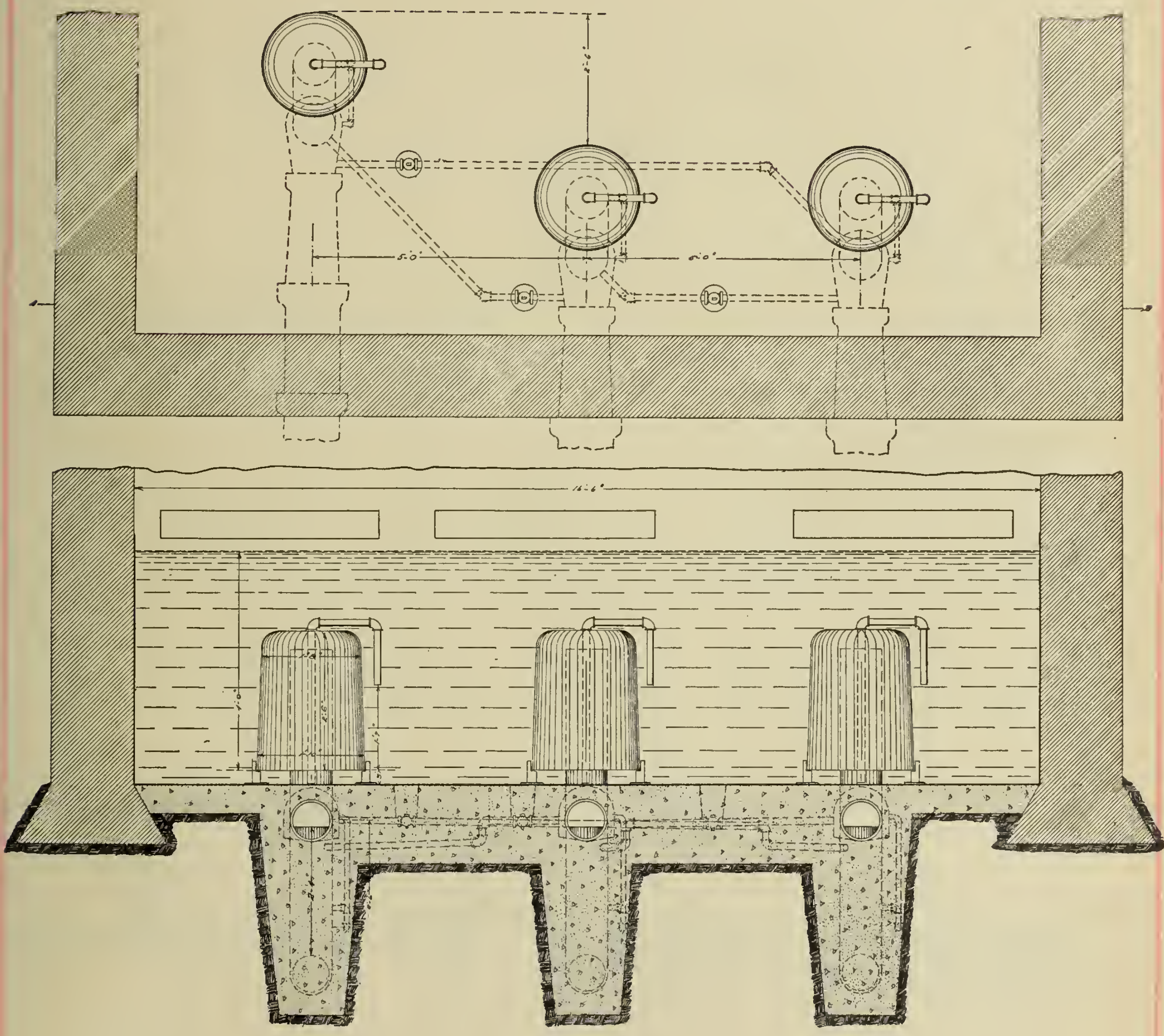
At the rise of water in the tank half the seal in all the traps is forced out, one of the siphons operates, draws the water from the tank down to the bottom of the bell, and when vented leaves its own trap full. The two idle siphons have their traps weakened an equal amount and either may operate at the next rise of water in the tank.

This condition is overcome by means of the piping shown in the drawing on Plate IX. As will be seen the discharge head of each siphon is connected to the short leg of one of the other traps. When one siphon operates some of the water flows through this pipe and refills the trap to which it is connected. The remaining siphon having no means of refilling its trap is left with a weak seal, and at the next rise of water will be the one to operate. This operation is repeated at the next rise, each discharging siphon filling its own trap and the trap of the idle siphon to which it is connected.

The general plan shows the application of the triple alternating siphons to three sand filter beds.

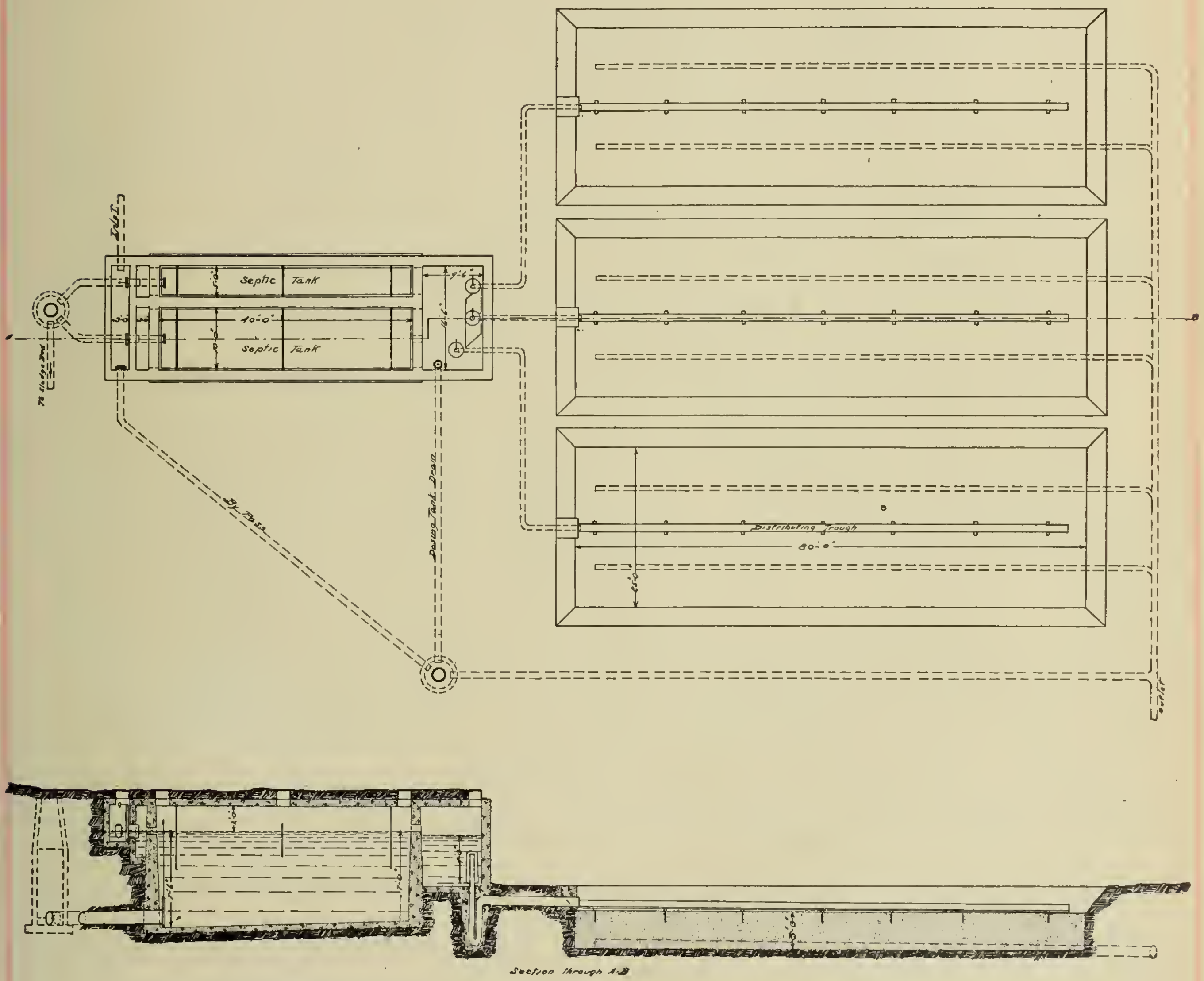
PLATE No IX a

Details of Adams Triple Alternating Siphons.



Section Through A-B

General plan of a Sewage Purification Plant showing the application of the Triple Alternating Siphons. Capacity of plant 45,000 gallans per day.



THE MILLER QUADRUPLE ALTERNATING SIPHONS.

When four or more siphons are set in the same tank, the system of piping used in the triplo alternating siphons becomes too complicated for practical construction. The principle is the same but another feature is introduced to do away with unnecessary piping.

As is shown in the drawing on the following page a water tight well is built just back of each siphon, its capacity being a little more than half that of the siphon traps. In this well is placed an overdraw siphon (A) connecting with the main siphon just in front of it; Also an auxiliary draining siphon (B) connecting with the siphon next to it. Well No.1 connecting with siphon No.2. Well No. 2 with siphon No.3. Well No.3 with siphon No.4 and Well No.4 with siphon No.1.

When the water rises in the tank half the water in the traps will be forced out, one siphon will operate and refill its own trap, leaving the remaining traps with their seals weakened, exactly the same as in the case of the triple alternating siphons.

The high water line to which the water in the tank rises being higher than the top of the wells, they will be filled when the water is drawn out of the tank by the main siphon and the wells will be left standing full, with one exception. The well just back of the siphon which has drawn the water from the tank is connected to that siphon by the overdraw (A). As can be seen this overdraw will work along with the main siphon and draw the water from the well at the same time the main siphon is drawing

it from the tank.

The condition existing when siphon No.1 ceases to operate is this, the trap of No.1 has been refilled, the others have weakened seals, Well No.1 is empty, the others are full, just as soon as siphon No.1 vents itself as well as the idle siphons, the auxiliary draining siphons (B) will begin to work. Well No.2 will drain its contents into siphon No.3, Well No.3 will drain into siphon No.4, Well No.4 will drain back into siphon No.1 but there is no water in Well No.1 to drain into siphon No.2 so it is left with a weakened seal, and at the next rise of water in the tank, it will be the one to operate. This operation is continuous, each siphon discharging successively its contents upon its respective bed.

DESIGN AND CONSTRUCTION.

In the design of alternating siphons for use in connection with sewage disposal, some changes must be made in the construction of the apparatus, owing to the fact that sewage instead of clear water passes through the siphons. In the ordinary flush tank siphon a 3/8" sniff hole bushed with brass is sufficient means of venting the siphon. However, this would soon become clogged or rusted up if used with sewage.

As is shown in Plate Xa, section through C-D, a 1½" pipe is run from the center of the bell to a point 5" from the bottom of the bell. This serves the same purpose as the sniff hole. By lengthening or shortening this vent pipe within the limit of the depth of trap, the discharging depth may be varied 4" or 5" either way, one limit being the maximum depth of water which the main trap will permit and the other limit a level an inch or so above the bottom of bell. The first discharging depth in alternating siphons is higher than those succeeding. This is due to the fact that for the first discharge the trap is full and for succeeding discharges it is only half full. This reduces the rise in the bell due to the displacement of the water in the trap, and increases the rise in the bell due to air compression. But the total rise in the bell is less with the trap half full, than when it is full, and the discharging depth is reduced an amount equal to the difference between the two rises in the bell.

In the operation of purification beds it is often found necessary to discontinue the use of one of the beds. For this purpose a system of cut off valves is provided so that any bed

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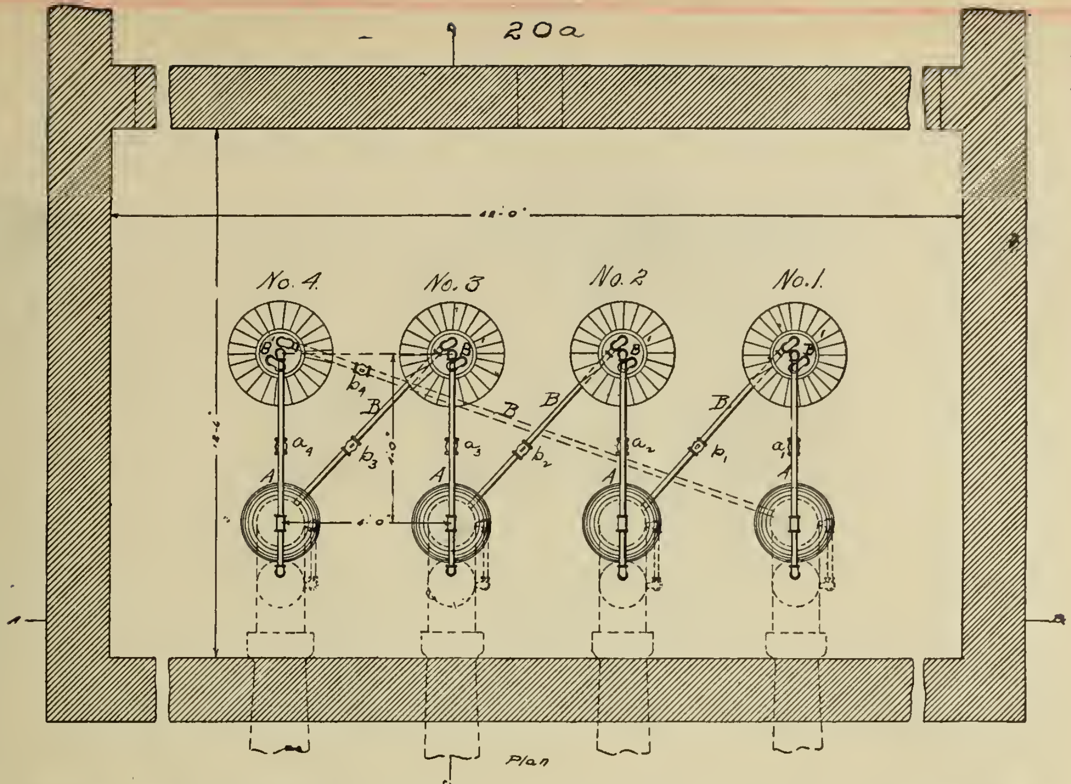
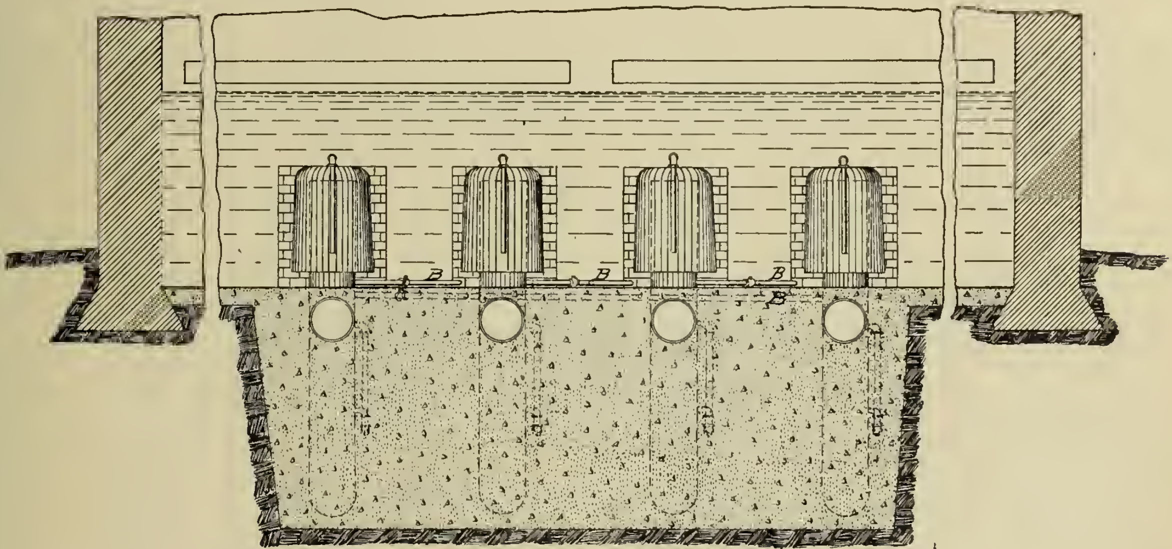
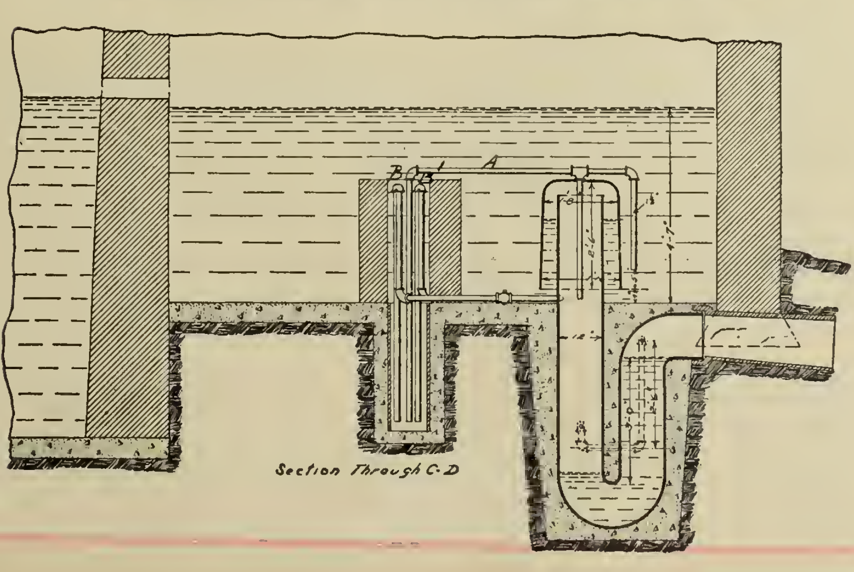
PLATE No. X a.



Plan



Section Through A-B



Section Through C-D

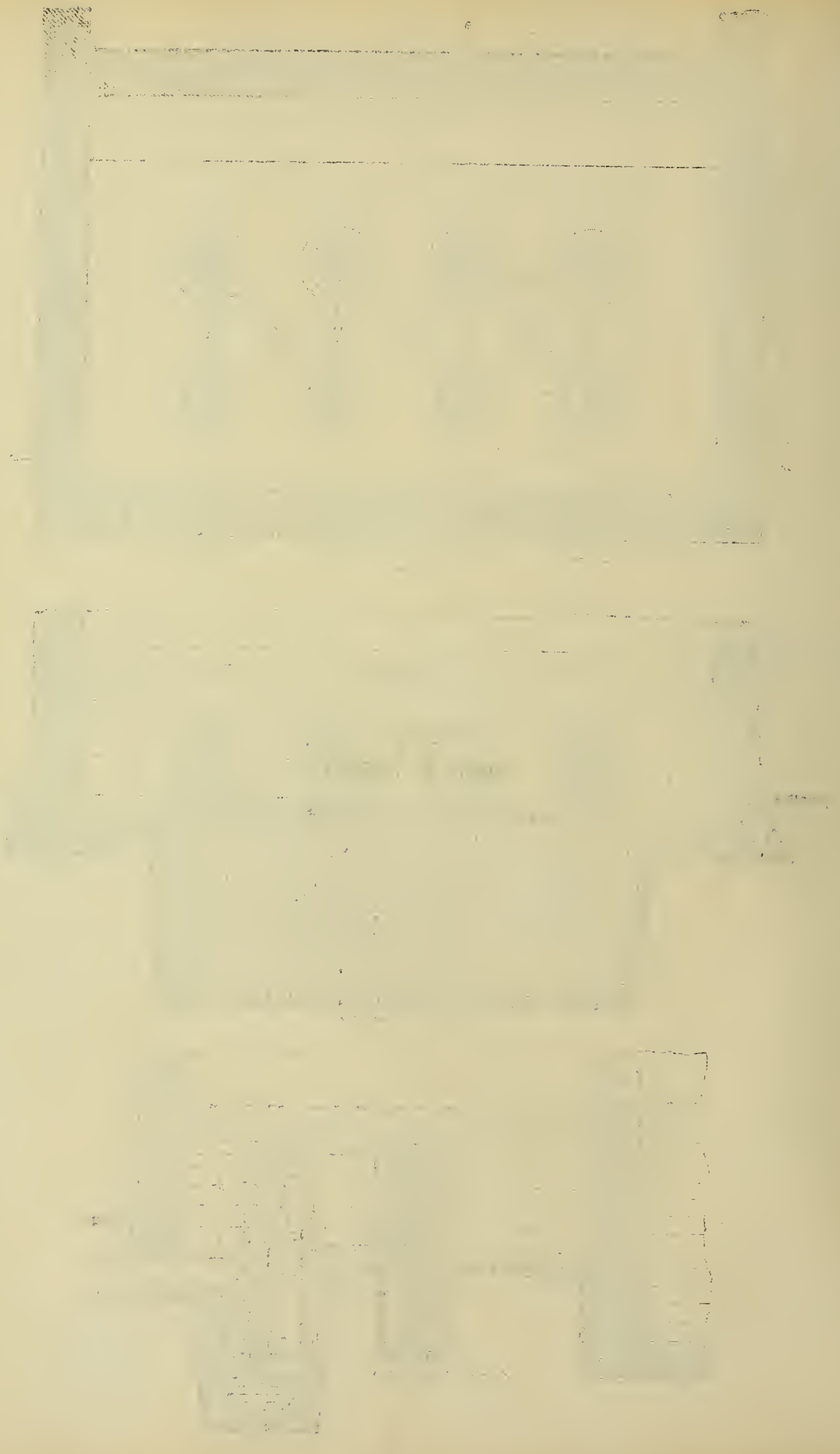
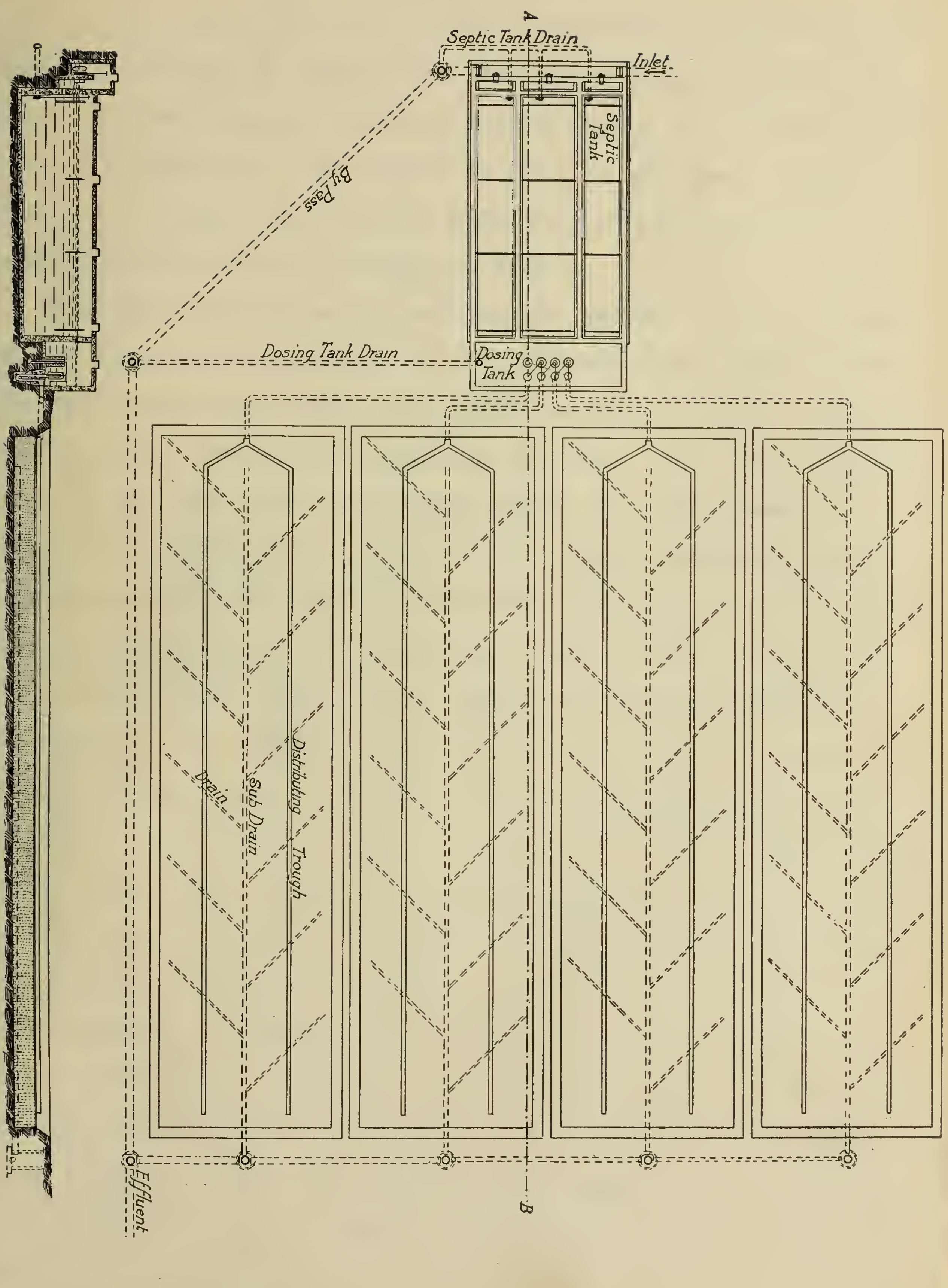


PLATE No X b.


A
Septic Tank Drain
Inlet
Septic Tank
By Pass
Dosing Tank Drain
Dosing Tank
Drain
Sub Drain
Distributing Trough
Section Through A-B.
Effluent.
B

may be cut out of the cycle without effecting the operation of those remaining. In addition to the valves it is necessary to have another auxiliary draining siphon in the well. This is shown at (B' in Plate Xa). The siphon is exactly the same as B but instead of connecting with the main siphon next to it, it connects with the one directly in front.

When all the siphons are working the valves a_1, a_2, a_3, and a_4 are closed and the valves b_1, b_2, b_3, and b_4 are open. Should it be desired to cut out siphon No.2, valve b_2 would be closed and a_2 opened, the others remaining the same. Let it be supposed that at the last rise in the tank siphon No.1 had operated, drained the water from the tank and refilled its own trap.The draining siphoms operate the same as before with one exception. The valve b in draining siphon B is closed and cannot drain the contents of well No.2 into siphom No.3. Valve a_2 in draining siphon B' is open, so the contents of well No.2 is drained into siphon No.2 All the traps are now full with the exception of siphon No.3. This will be the one to operate at the next rise of water in the tank. Siphon No.2 is cut out. Byopening and closing the corresponding valves in any of the other draining siphons any one of the main siphons may be cut out.

The general plans here used, show the siphons only in connection with sand filtration. They can be used just as easily and satisfactorily with the contact bed. Nor is it necessary that they be set in a straight line. A drawing on the next page shows six siphons set in a circular form. The principle is just the same.

[illegible] of the cycle without [illegible] the [illegible]

[illegible]. In addition, [illegible] the valves [illegible]

[illegible] auxiliary [illegible] in the [illegible].

[illegible]. The [illegible] the same [illegible]

[illegible] with the [illegible]

[illegible] with the [illegible].

When all the siphons are working the valves [illegible]

[illegible] the valves [illegible] are open. Should

it be desired [illegible]

and a [illegible]

that at the [illegible] siphon No. [illegible]

[illegible]

[illegible]

[illegible]

[illegible] siphon [illegible]

[illegible] No. [illegible] siphon [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

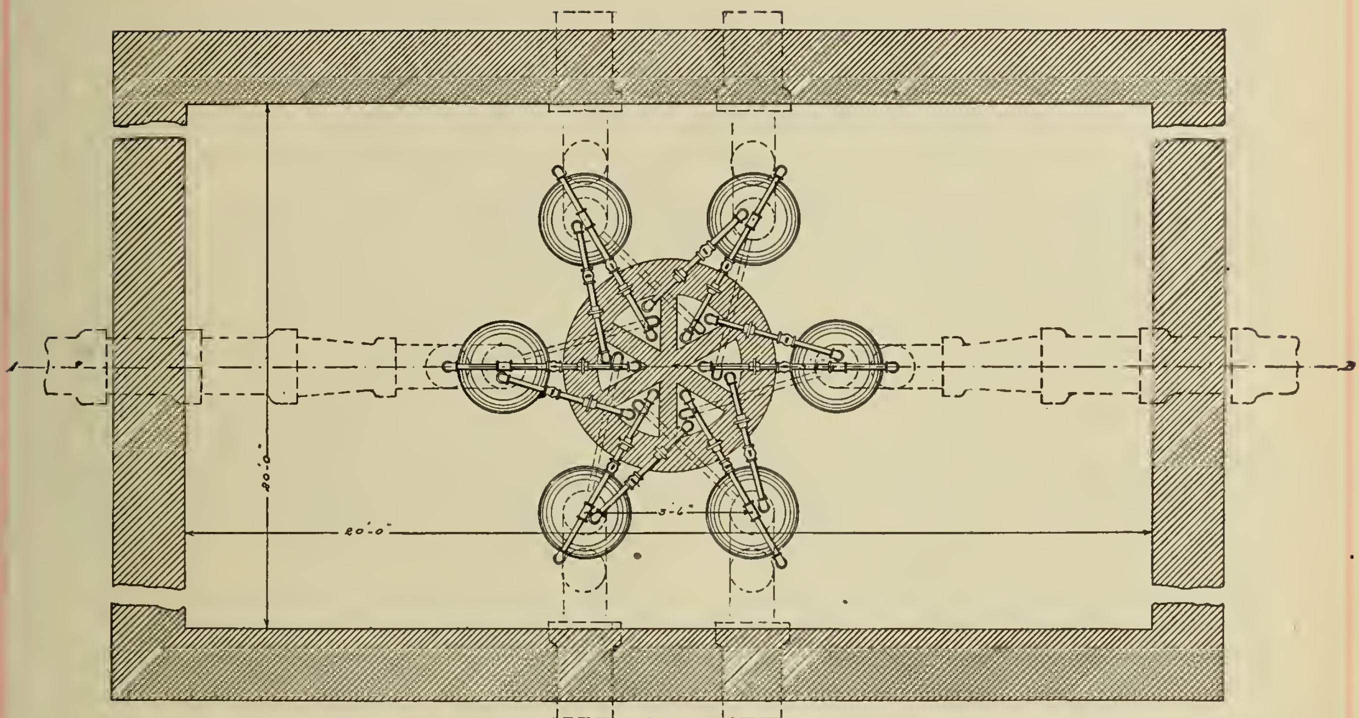
[illegible]

[illegible]

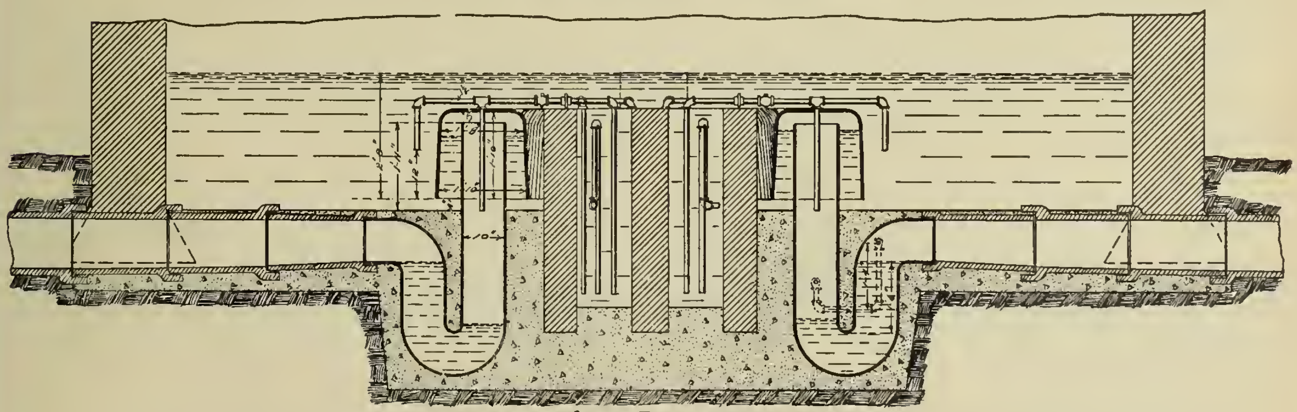
[illegible]

[illegible]

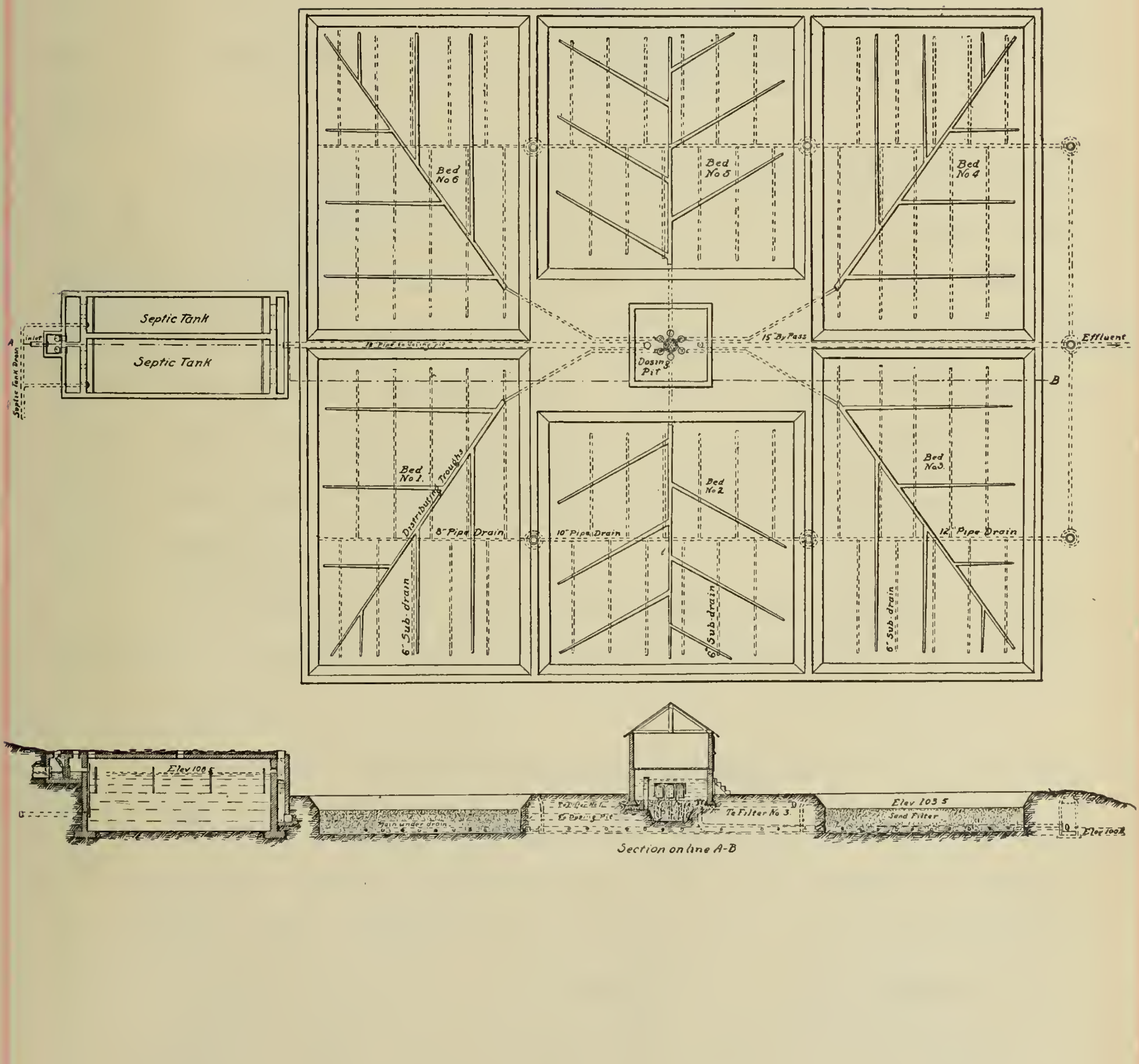
[illegible]



PLAN



SECTION THROUGH A-B



Section on line A-B

THE ADAMS FEEDS.

Very often the condition governing the design of a sewage disposal plant is the amount of fall from the high water level in the septic tank to the final outlet of the effluent. In case there is plenty of fall siphons can be used to some advantage. On the other hand if the fall is slight some other apparatus has to be used.

For this purpose S.H.Adams has invented what is known as the Adams Air Lock Feeds. There is but one restriction on their use. They will work only with contact beds, water tight beds.

As is shown in the drawing on the next page, the feed itself consists of but one casting, that shown at (A) in the section on (A-B). However there is some auxiliary apparatus such as compressed air domes, blow off traps and over draw siphons necessary to its operation.

The drawing shows a receiving basin containing two feeds which will alternate and fill their respective beds, the same as did the siphons.

The sewage flows from the septic tank into the receiving basin, and from there through one of the feeds and out upon the bed. The flow upon the beds being at the same rate as that from the septic tank. The beds being water tight this flow continues until the bed is full. At this point some of the sewage in the bed is siphoned into the compressed air chamber (C) by means of the auxiliary overdraw siphon (B). As the water rises in this chamber it compresses the air in the large dome (E) and forces it through the pipe (F) into the feed which has been operating.

The capacity of the dome (E) is somewhat larger than that of the feed, so enough air is forced into the feed to form a cushion in the top of the feed and so lock it.

At the same time the air is compressed in the large dome it is also compressed in the smaller one. This dome is connected by the pipe (G) to a blow off trap in the other chamber. This trap is under a water seal of about 12". This seal is driven out by the compressed air in the small dome. The trap being connected with the idle feed, as is shown in the drawing, upon having its seal blown out releases the confined air in that feed and starts it in operation.

The first feed has in the meantime ceased operating and the sewage is left in contact with the material in the bed for a period of an hour or two. At the end of this time it is drawn out, and as it recedes the overdraw siphon at (B) again operates and draws the water from the compressed air chamber and back to the bed.

The bottom level of the siphon leg in the chamber is below the bottom of the bells so that in emptying the bells will be vented. The blow off trap is left full of water and its top being below the bottom of the bells, it is left uncovered and free to have its seal blown at the next rise of water in the air chamber.

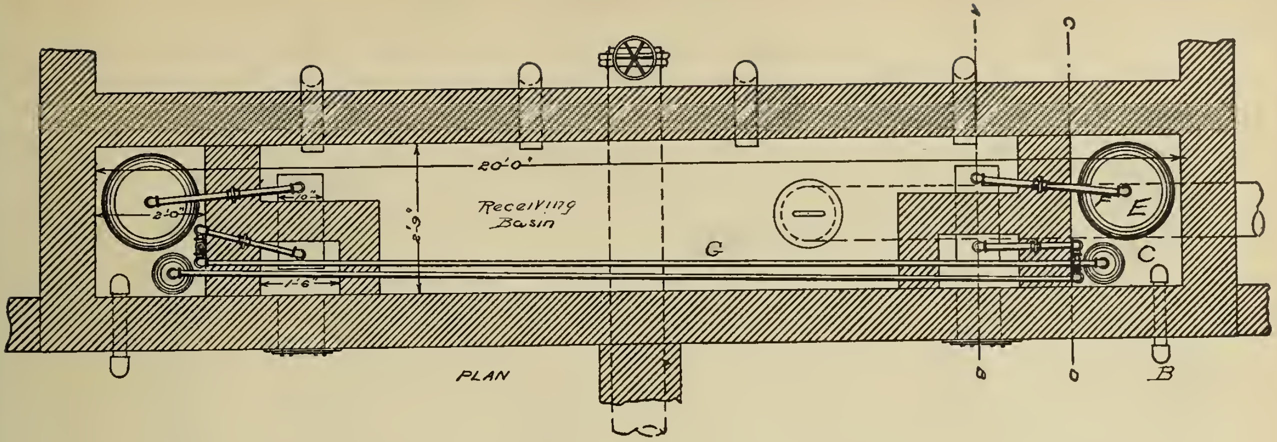
As can be seen by the other drawings, this method can be applied to any number of feeds.

DESIGN AND CONSTRUCTION.

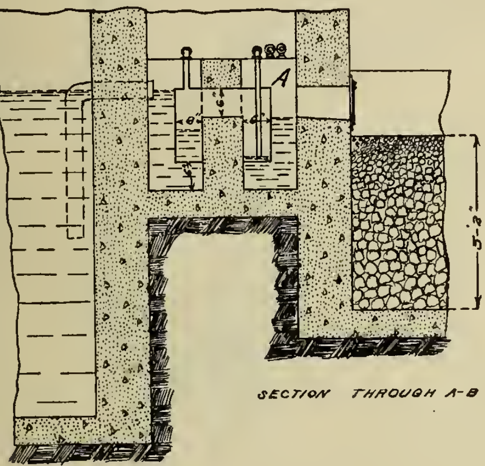
The size of a feed is governed by the amount of inflow of the sewage per hour.The cross section of the feed is made of such size that when the feed is flowing full it will take care of the total inflow. However when acting under a head the discharge is somewhat greater.

From the cubical contents of the feed, the size of the large compressed air dome is determined. Its capacity will be somewhat larger than that of the feed, in order to insure that there will be sufficient air forced into the feed to choke it.

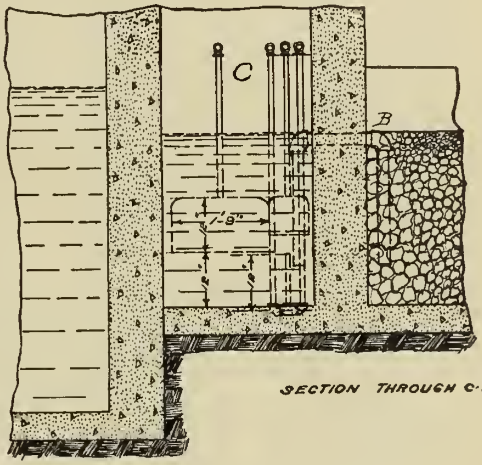
As in the case of the alternating siphons some provision must be made for cutting out one of the beds. The piping containing the valves shown in Plate XIVa provides for this. From the explanation given on page 23 it is easy to trace the course of the air going from one feed to the other when all are in operation. The valves at A, B, C and D are of the three way pattern and when all the feeds are working in rotation these valves are set so that the air passes directly from the small dome to the blow off trap of the next feed, and does not enter the cut off pipes at anytime. Should it be desired to cut out feed No.2 valves a and b would be opened, c and d closed and A and B turned so that the air would take the course indicated by the arrows. From this course it can be seen that the small dome of bed No.1 will force the trap connecting with feed No.3 thus cutting out feed No.2



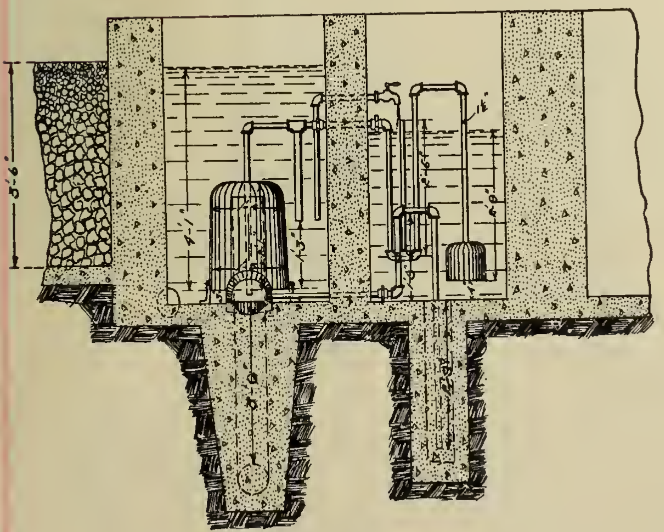
PLAN



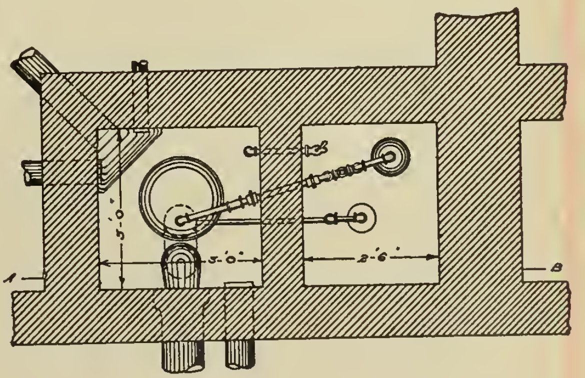
SECTION THROUGH A-B



SECTION THROUGH C-D



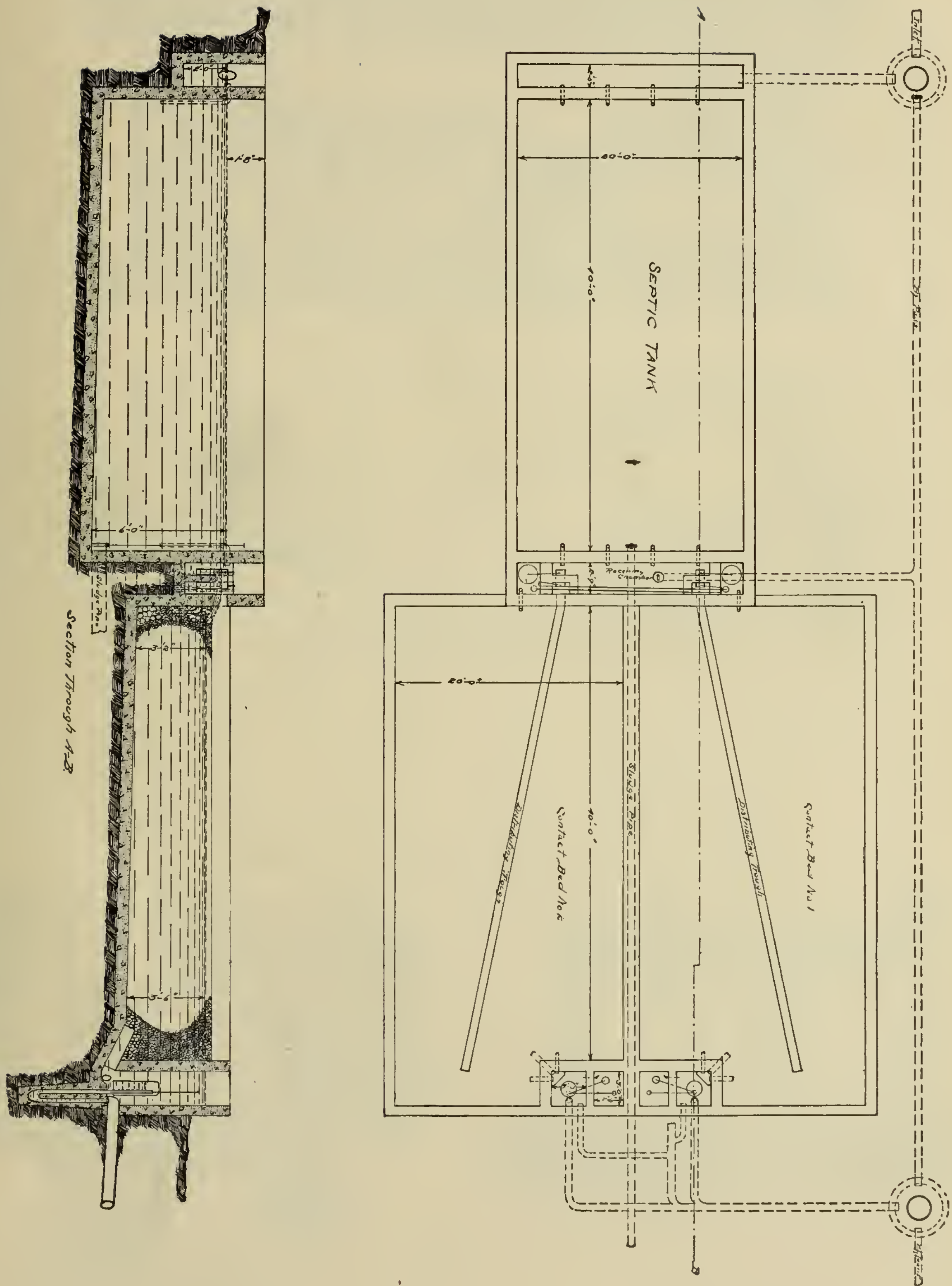
SECTION THROUGH A-B



PLAN

Miller Timed Siphons, used in connection with the above Adams Feeds as shown on Plate 12b.

PLATE No. XII D



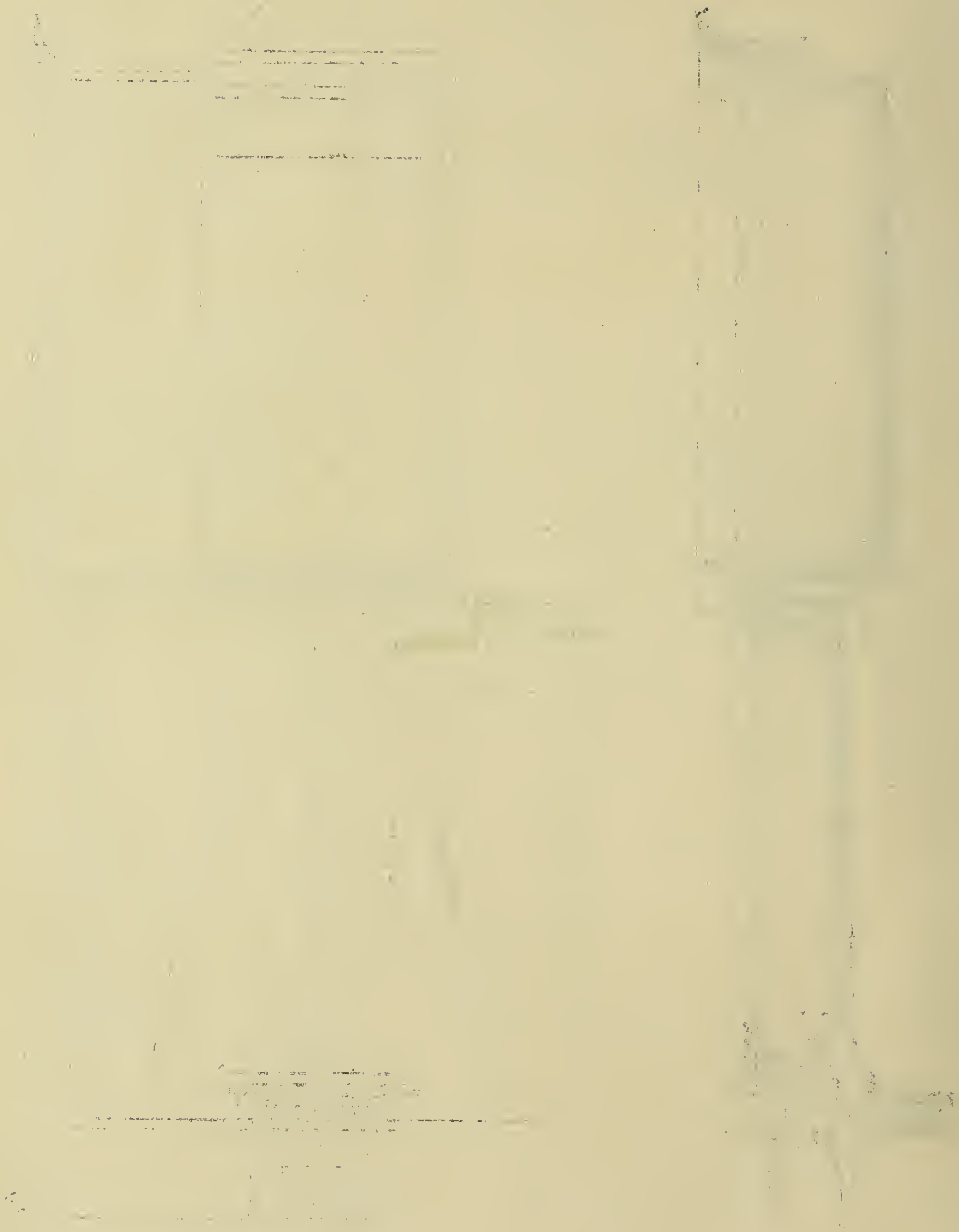
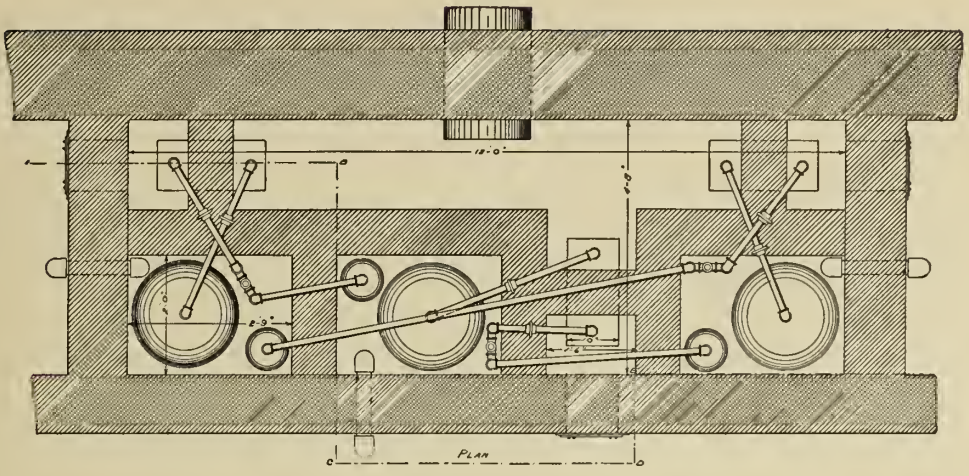
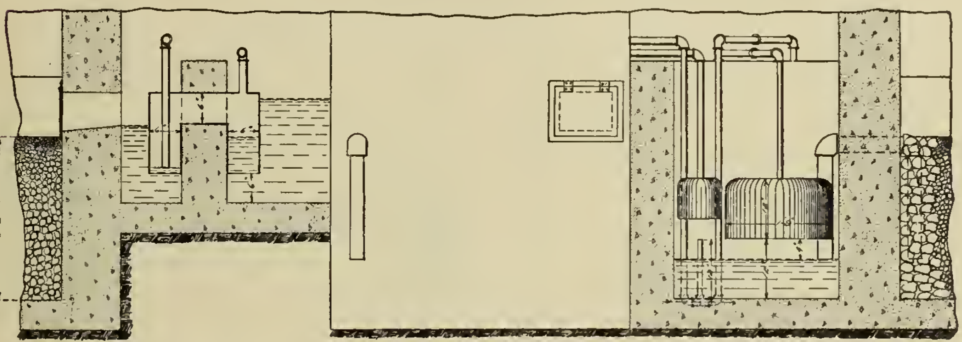


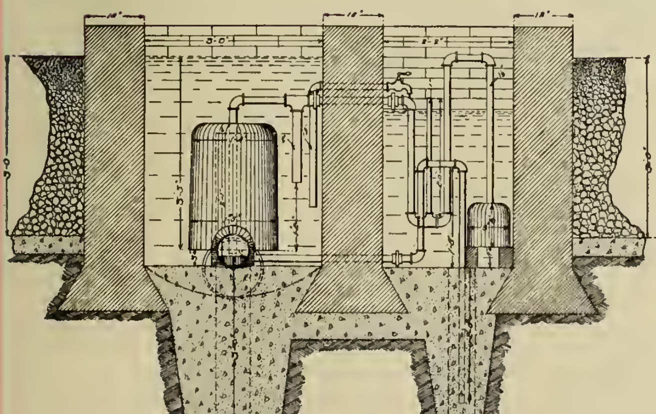
PLATE No XIII a



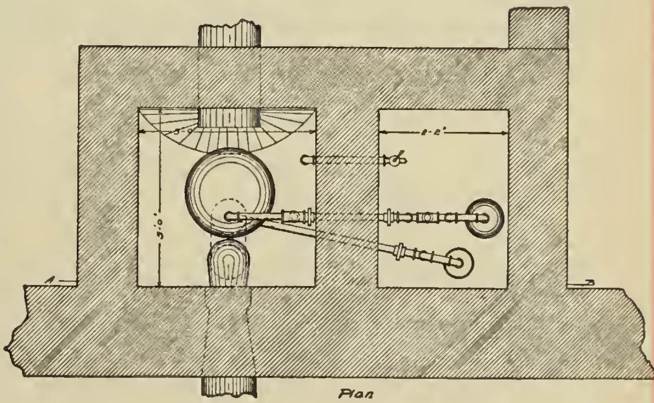
Plan



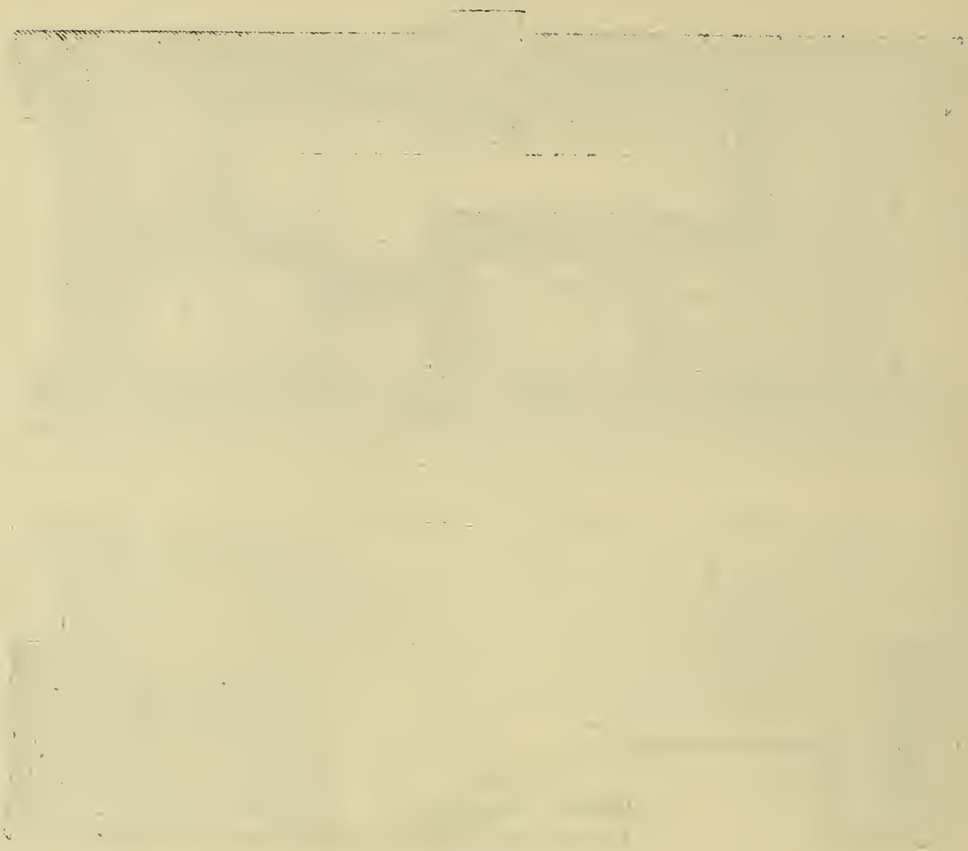
Section Through A·B·C·D·E·F

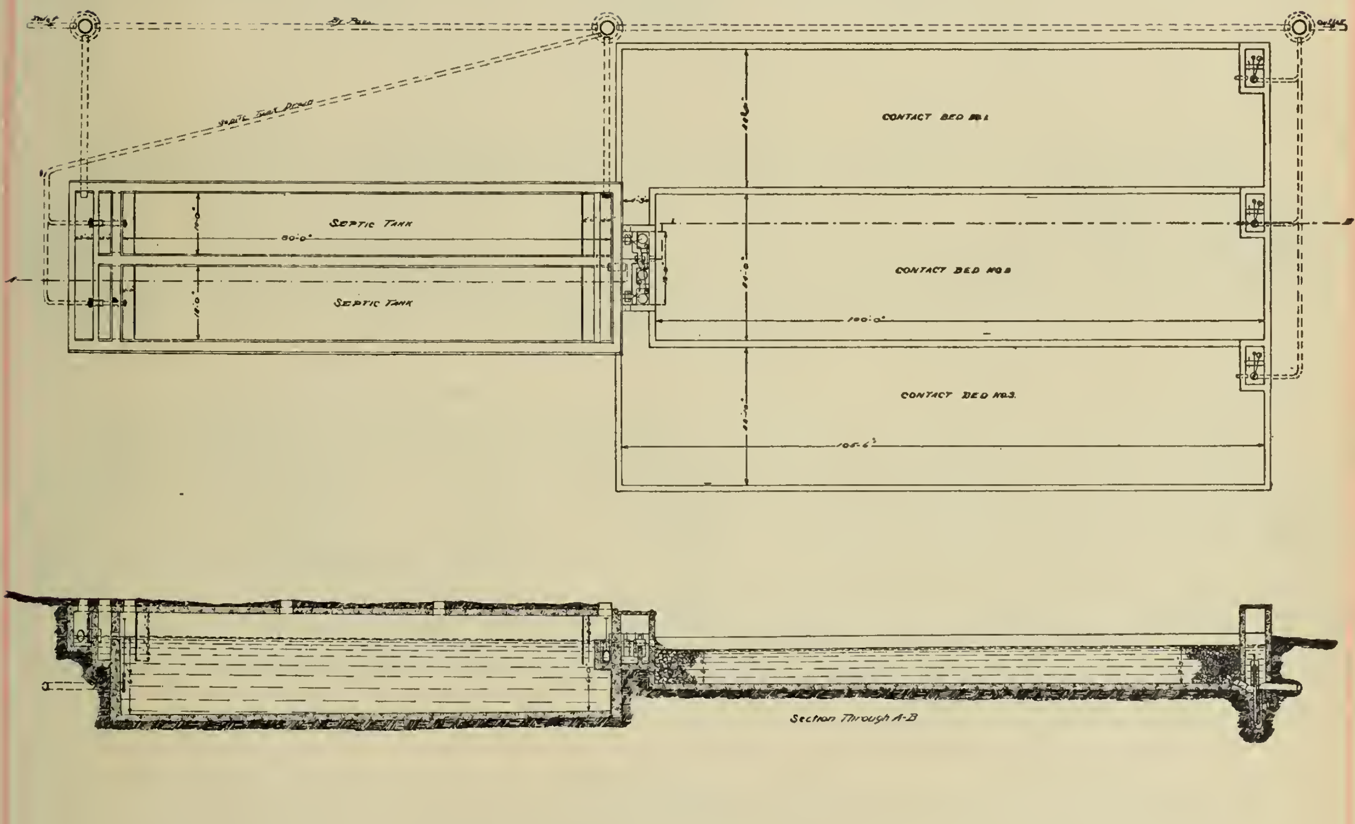


Section Through A·B



Plan



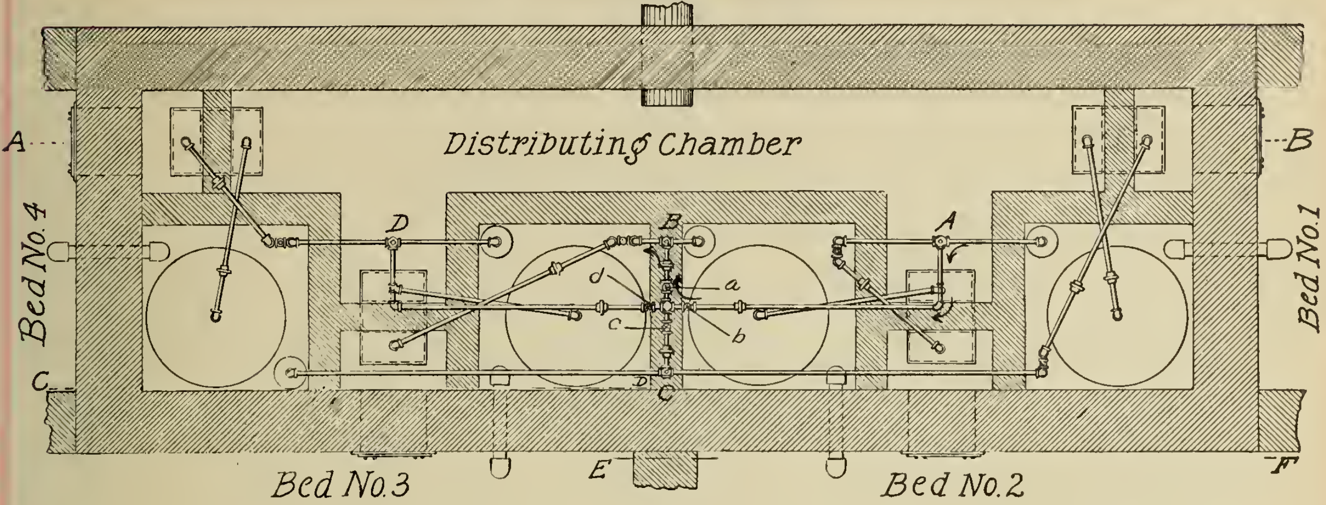


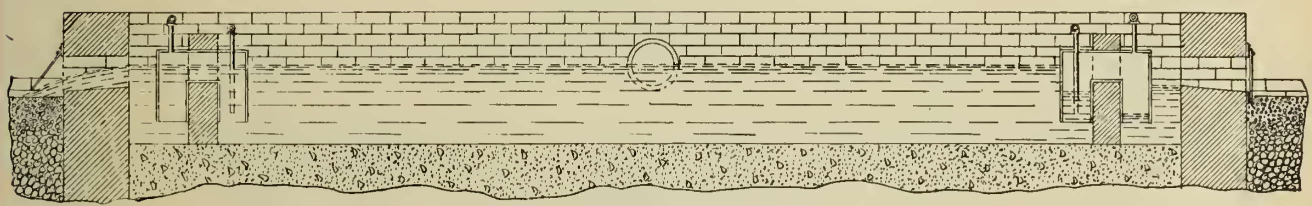
Section Through A-B

PLATE No. XIV a

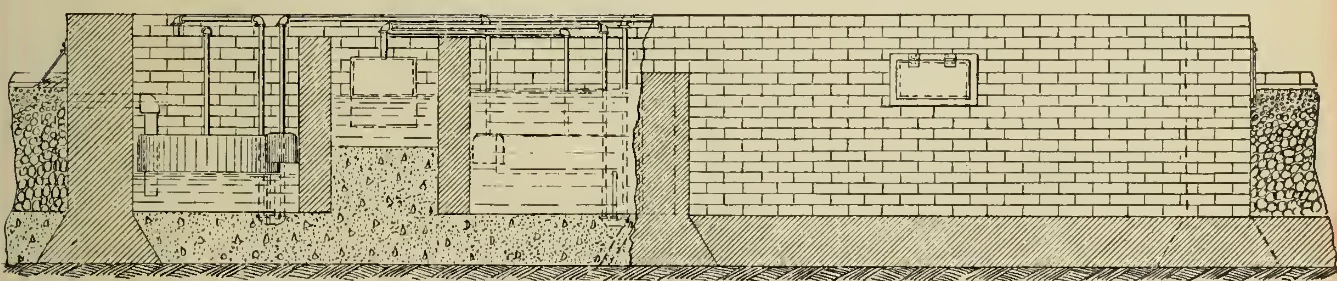
Details of Air Lock Feeds and Distributing Chamber

shown in plan on opposite page.





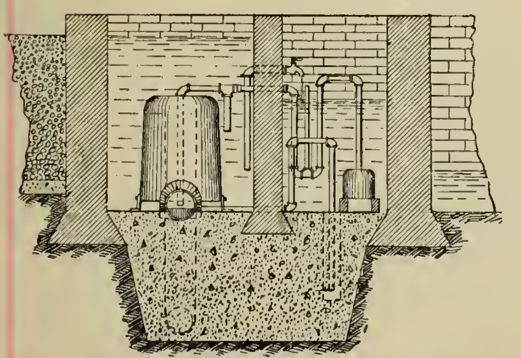
Section through A-B



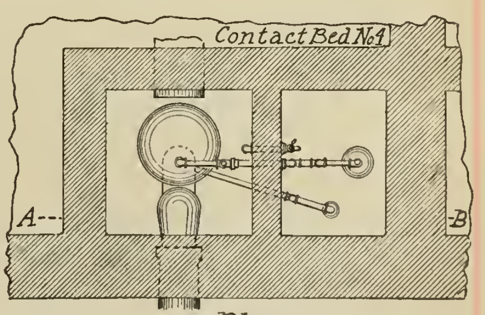
Section through C-D

Section through E-F

Details of Timed Siphons

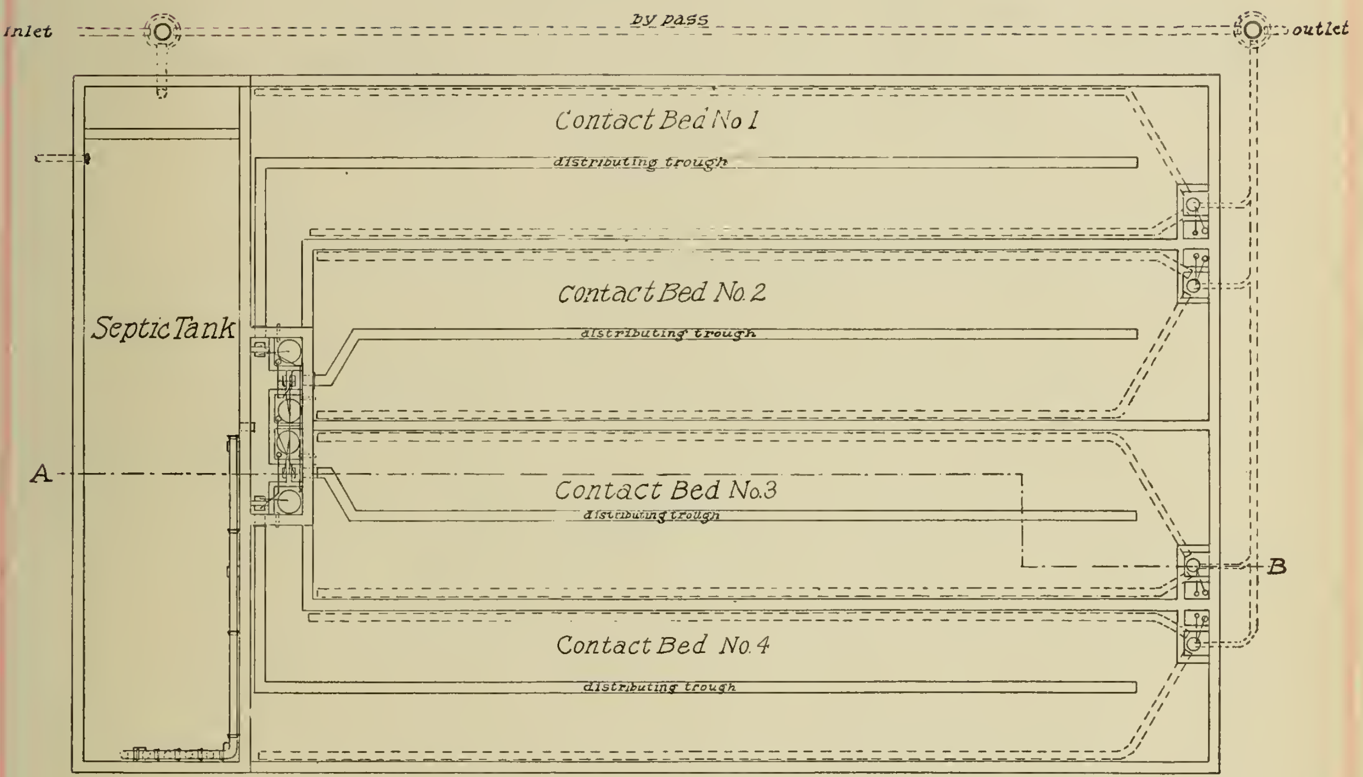


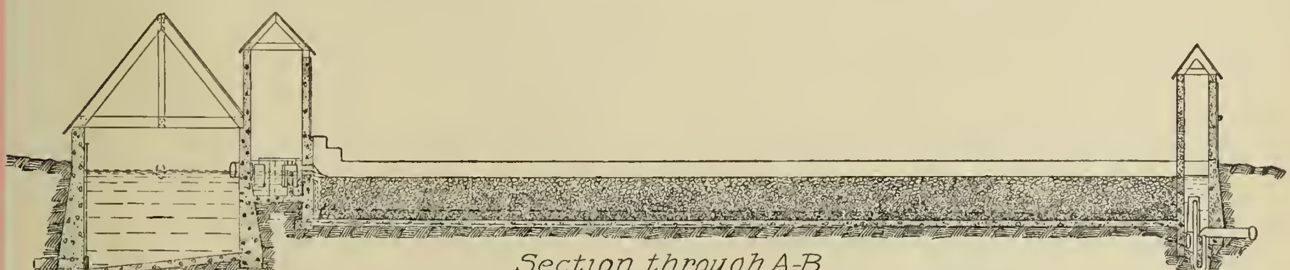
Section through A-B



Plan

PLATE No XIV b

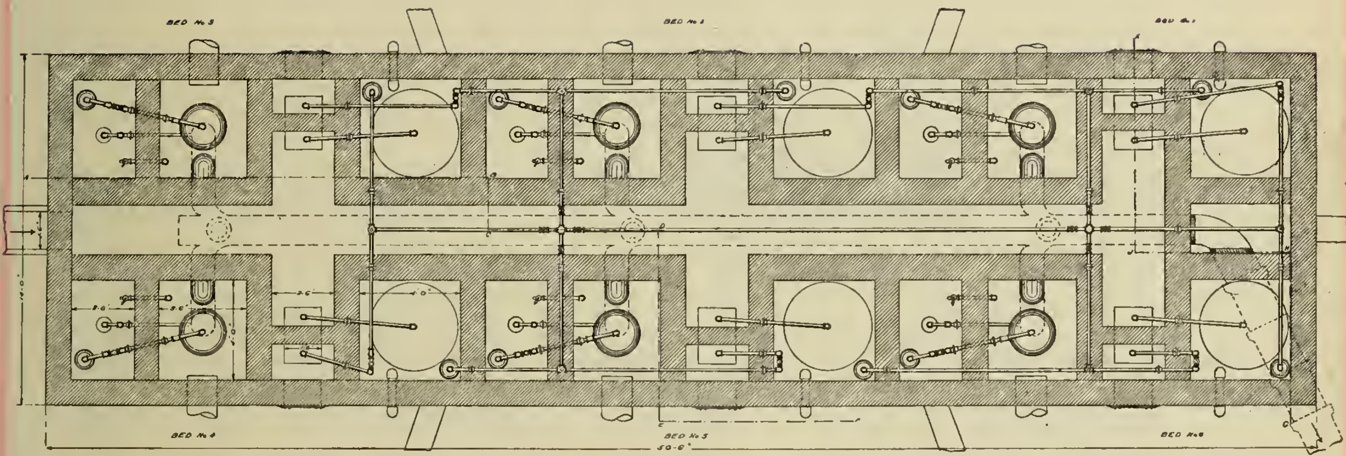


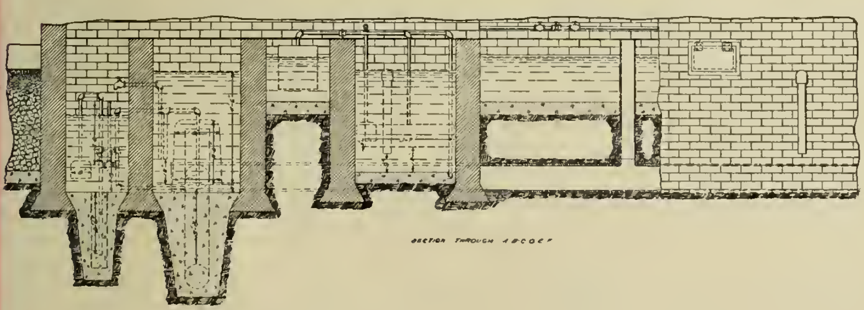


Section through A-B
1' horizontal = 2' vertical

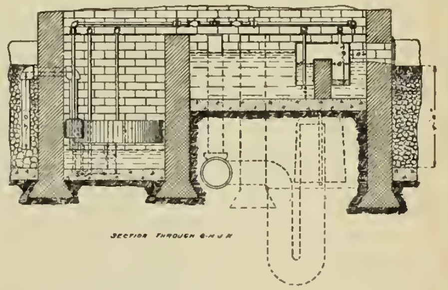
The drawings shown on Plates XVa and XVb were designed in order that the Adams Air Lock Feeds and Miller Timed Siphons could be put under one roof. The operation of each part of the apparatus is however independent of the other, and the same as heretofore described.

PLATE No XVa

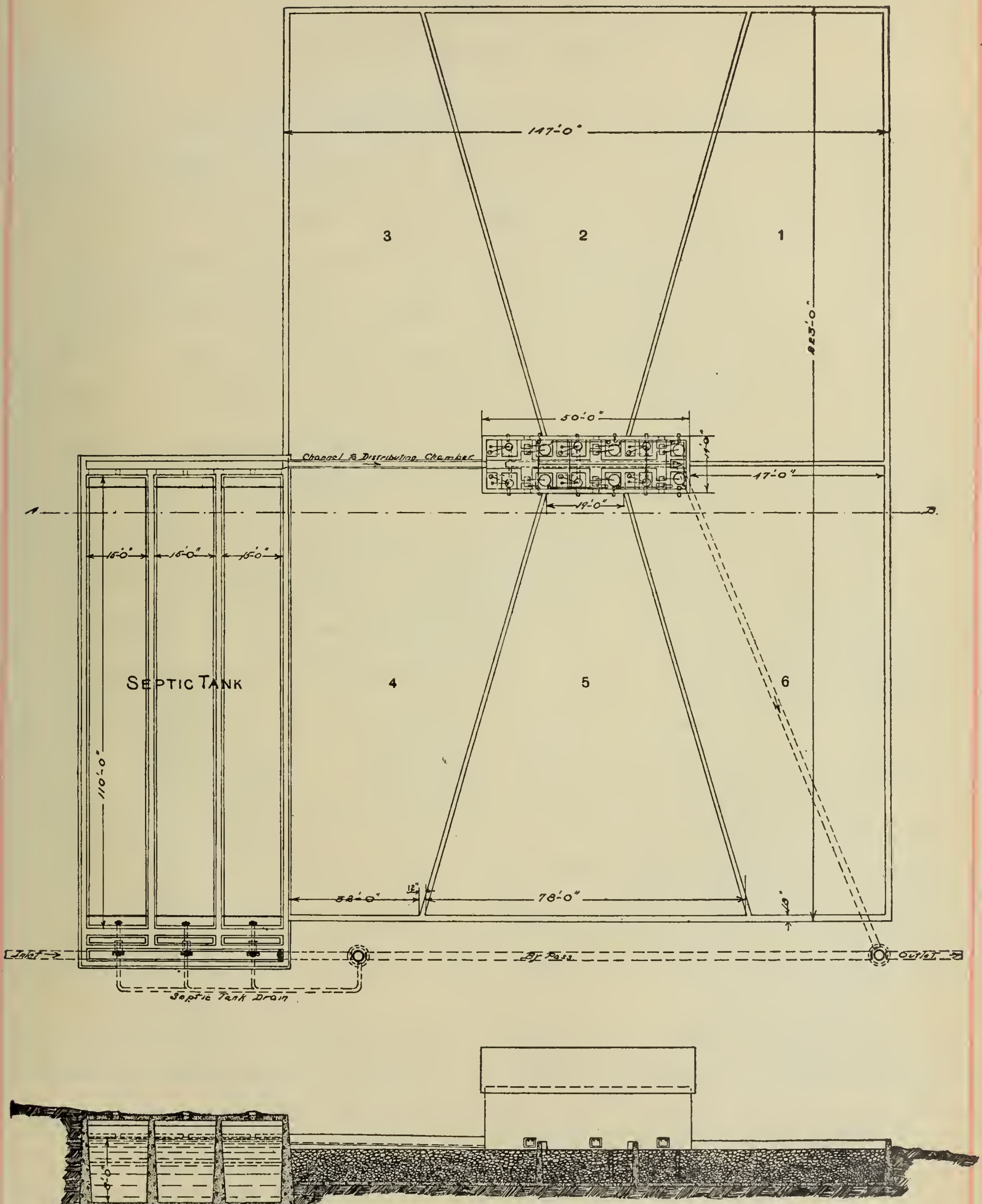




SECTION THROUGH A B C D E F



SECTION THROUGH G-H-J-K



Section Through A-B.

THE MILLER TIMED SIPHON.

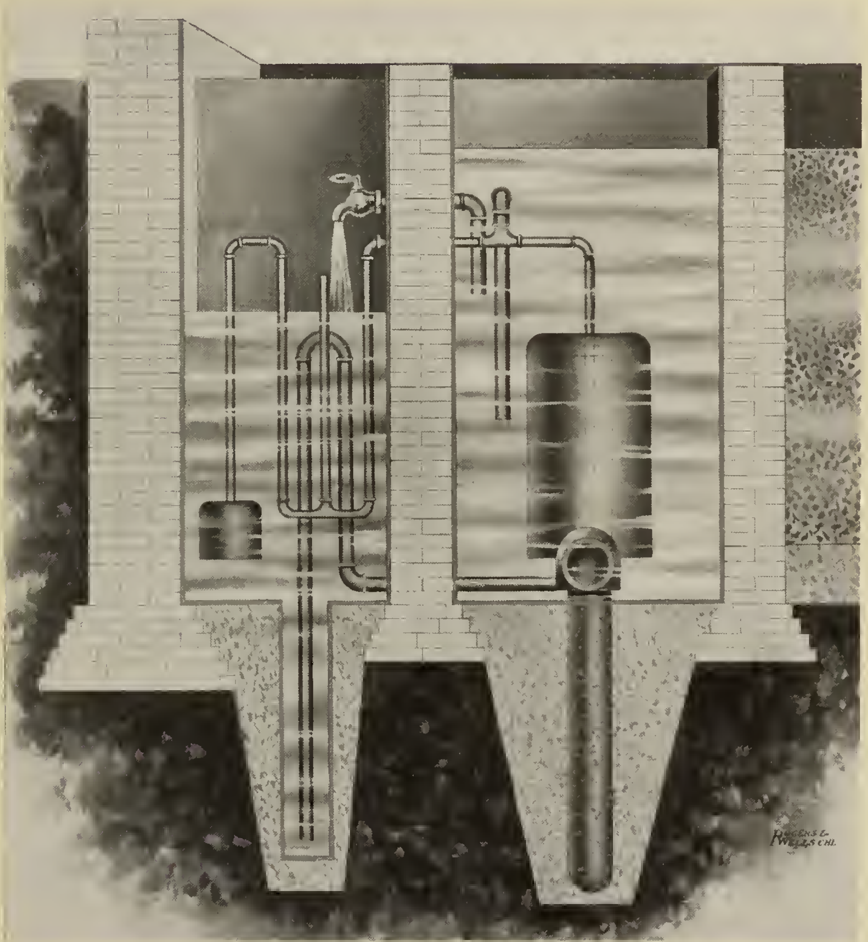
In contact beds the sewage is left in contact in the beds for a certain period and is then drawn out. For this purpose, what is known as the Miller Timed siphon, shown on Plate XVI. has been very successfully used. This consists essentially of a siphon chamber, and a timing chamber. The first contains the main siphon through which flows the sewage from the beds to the final outfall. The timing chamber contains the blow off trap, compressed air dome and draining siphon.

The sewage flows from the bed into the siphon chamber, but at no time is a head obtained sufficient to start the large siphon. From the siphon chamber some of the sewage flows into the timing chamber through the small pet cock. The flow through this pet cock is regulated so that it will just fill the timing chamber in the required time of contact.

As the water rises in the timing chamber it compresses the air in the dome, and when sufficient head is procured, blows the seal out of the blow off trap. This trap being connected through the wall with the main siphon, upon having its seal blown, releases the air in the main siphon and starts it in operation.

The water is drawn from the bed and at the same time the water in the timing chamber is withdrawn through the auxiliary draining siphon into the main siphon and then into the outfall.

MILLER TIMED SIPHON.



The drawings and designs used in the printed plates were made by the writer of the thesis while in the employ of S.W. Miller during the time he was engaged in the invention and development of the forms of the Miller controlling apparatus and the improvement of the Adams Feeds herein described. The details of the apparatus, the proportioning of the parts, and the design and arrangement of the sewage purification plants with the exception of that shown in Plate XIVb were made by the writer.